THE CONVENTION OF THE INTERNATIONAL ELECTRO TECHNICAL COMMISSION AND THE RECENT INTERNATIONAL CONFERENCE UPON ELECTRICAL UNITS AND STANDARDS.

ELECTROTECHNICAL COMMISSION. — The International Electrotechnical Commission which met in London, England, during the week of Oct. 19, had its inception due to a paper on standardization read by Col. R. E. B. Crompton before a meeting of the government delegates to the International Electrical Congress at St. Louis in 1904. At that meeting it was resolved that steps should be taken to secure the cooperation of the technical societies of the world for the appointment of a representative commission to consider the standardization of electrical machinery and apparatus. A preliminary meeting was held in London in June, 1906, when Lord Kelvin was elected President and Col. Crompton as Honorary Secretary. Rules for standardization were provisionally adopted and the secretary was authorized to continue a further organization of the movement.

The first business of the recent meeting was to elect a new president. Prof. Elihu Thomson, of Lynn, Mass., U. S. A., was elected by acclamation. Col. Crompton was re-elected Honorary Secretary.

In the report of the Honorary Secretary it was stated that the council of the Institution of Electrical Engineers had given $1,000 and had loaned $1,000 to assist in the formation of the central office of the commission. It was also reported that there were ten electrotechnical committees organized in good working shape in as many countries. Six more were about to be started and still another six were under consideration.

The ratification of the 1906 rules came up for debate but the records do not show that decisive action was taken. The location of the central office of the Commission and the change of the name of local committees, serving for the various countries, to electrotechnical committees were adpoted without discussion. The French delegation proposed a radical modification of the way in which the recommendations of the Commission should be promulgated. After much debate a compromise measure was accepted and is expressed in the following rule:

> Each country shall be entitled to one vote only, either by person, by proxy or by correspondence, whatever number of delegates it may appoint. Only such decisions may be published as those of the International Electrotechnical Commission which have been passed by a majority of at least four-fifths of the votes registered.

There were several proposals as to the system on which the rules and nomenclature should be drawn up for publication. The German delegates proposed a cooperative scheme with the publishers of a technical dictionary. Such a move, however, was not approved as it was the general sentiment that the function of the Commission was not to prepare a complete dictionary but rather to define and explain certain terms for international use. The following basis for the intercommunication of work was adopted:

> Each Electrotechnical Committee should forthwith commence its work in nomenclature by preparing an electrotechnical glossary, arranged in alphabetical order, in its own language. These terms, together with their explanations translated into the official languages of the Commission (English and French), shall, as soon as the list for the first five letters (A—E) is completed, be forwarded to the central office for communication to the other Electrotechnical Committees. The same procedure shall be followed for the next five letters, and so on until the alphabet is completed. In carrying out this work each Electrotechnical Committee should, as far as practicable, utilize the work already done by others, to whom due credit should be given in each case.

The subjects of a provisional standard of light and the metric system were discussed. The first subject was passed over to enable the committees to become more fully informed and to attempt to harmonize the interests of gas and electric industries in such a work. It was agreed that such figures as were necessary in the recommendations of the Commission should be expressed in the metric system. It was conceded, however, that for countries which did not generally employ the metric system, there should be the right to express the equivalent value in brackets.

CONFERENCE ON UNITS AND STANDARDS.—The International Conference Upon Electrical Units, which was called together by the British Government, held several sessions in London during the two weeks following Oct. 12. The main object of this conference is to obtain international agreement on the three fundamental electrical units, the volt, the ohm and the ampere.

Lord Rayleigh acted as President of the conference.

The conference adopted the following resolutions and specifications, officially known as "Schedule B," and requested the delegates to lay them before their respective governments for adoption:

1. The Conference agrees that as heretofore the magnitudes of the fundamental electric units shall be determined on the electromagnetic system of measurement with reference to the centimeter as the unit of length, the gramme as the unit of mass, and the second as the unit of time. These fundamental units are (1) the ohm, the unit of electric resistance which has the value of 1,000,000,000 in terms of the centimeter and second; (2) the ampere, the unit of electric current which has the value of one-tenth (0.1) in terms of the centimeter, gramme, and second; (3) the volt, the unit of electromotive force which has the value 100,000,000 in terms of the centimeter, the gramme, and the second; (4) the watt, the unit of power which has the value 10,000,000 in terms of the centimeter, the gramme and the second.

2. As a system of units representing the above and sufficiently near to them to be adopted for the purpose of electrical measurements and as a basis for legislation, the Conference recommends the adoption of the international ohm, the international ampere, and the international volt defined according to the following definitions.

3. The ohm is the first primary unit.

4. The international ohm is defined as the resistance of a specified column of mercury.

5. The international ohm is the resistance offered to an unvarying electric current by a column of mercury at the temperature of melting ice, 14.4521 grammes in mass, of a constant cross sectional area, and of a length of 106.300 centimeters. To determine the resistance of a column of mercury in terms of the international ohm, the procedure to be followed shall be that set out in Specification 1, attached to these resolutions.

6. The ampere is the second primary unit.

7. The international ampere is the unvarying electric current which, when passed through a solution of nitrate of silver in water, in accordance with the Specification II. attached to these resolutions, deposits silver at the rate of 0.00111800 of a gramme per second.

8. The international volt is the electrical pressure which, when steadily applied to a conductor whose resistance is one international ohm, will produce a current of one international ampere.

9. The international watt is the energy expended per second by an unvarying electric current of one international ampere under an electric pressure of one international volt.

Specification I.—(Specification Relating to Mercury Standards of Resistance)—The glass tubes used for mercury standards of resistance must be made of a glass such that the dimensions may remain as constant as possible. The tubes must be well annealed and straight. The bore must be as nearly as possible uniform and circular, and the area of cross-section of the bore must be approximately one square millimeter. The mercury must have a resistance of approximately one ohm. Each of the tubes must be accurately calibrated. The correction to be applied to allow for the area of the cross-section of the bore not being exactly the same at all parts of the tube must not exceed five parts in 10,000. The mercury filling the tube must be considered as bounded by plane surfaces placed in contact with the ends of the tube. The length of the axis of the tube, the mass of mercury the tube contains, and the electrical resistance of the mercury are to be determined at a temperature as near to 0° C. as possible. The measurements are to be corrected to 0° C. For the purpose of the electrical measurements, end vessels carrying connections for the current and potential terminals are to be fitted on to the tube. These end vessels are to be spherical in shape (of a diameter of approximately four centimeters) and should have cylindrical pieces attached to make connections with the tubes. The outside edge of each end of the tube is to be coincident with the inner surface of the corresponding spherical end vessel. The leads which make contact with the mercury are to be of thin platinum wire fused into glass. The point of entry of the current lead and the end of the tube are to be at opposite ends of a diameter of the bulb; the potential lead is to be midway between these two points. All the leads must be so thin that no error in the resistance is introduced through conduction of heat to the mercury. The filling of the tube with mercury for the purpose of the resistance measurements must be carried out under the same conditions as the filling for the determination of the mass. The resistance which has to be added to the resistance of the tube to allow for the effect of the end vessels is to be calculated by the formula.

$$A = \frac{0.80}{1,033\pi}\left(\frac{1}{r_1}+\frac{1}{r_2}\right)\text{ohm},$$

where r_1 and r_2 are the radii in millimeters of the end sections of the bore of the tube. The mean of the calculated resistances of at least five tubes shall be taken to determine the value of the unit of resistance. For the purpose of the comparison of resistance with a mercury tube the measurements shall be made with at least three separate fillings of the tube.

Specification II.—(Specification Relating to the Deposition of Silver).—The electrolyte shall consist of a solution of from 15 to 20 parts by weight of silver nitrate in 100 parts of distilled water. The solution must only be used once, and only for so long that not more than 30% of the silver in the solution is deposited. The anode shall be of silver, and the cathode of platinum. The current density at the anode shall not exceed 1/5 ampere per sq. cm. and at the cathode 1/50 ampere per sq. cm. Not less than 100 cu. cm. of electrolyte shall be used in a voltameter. Care must be taken that no particles which may become mechanically detached from the anode shall reach the cathode. Before weighing, any traces of solution adhering to the cathode must be removed, and the cathode dried.

The Conference recommended the use of the Weston cell, as a convenient method of measuring E.M.F. for voltage and current determinations, when set up in accordance with the following specification officially known as Schedule C.

The Weston normal cell may be conveniently employed as a standard of electric pressure for the measurement both of E.M.F. and of current, and when set up in accordance with the following specification, may be taken, provisionally, as having, at a temperature of 20° C., an E.M.F. of 1.0184 volts.

Specification Relating to the Weston Normal Cell.—The Weston normal cell is a voltaic cell which has a saturated, aqueous solution of cadmium sulphate ($CdSO_4 8/3 H_2O$) as its electrolyte. The electrolyte must be neutral to Congo red. The positive electrode of the cell is mercury. The negative electrode of the cell is cadmium amalgam consisting of 12.5 parts by weight of cadmium in 100 parts of amalgam. The depolariser, which is placed in contact with the positive electrode, is a paste made by mixing mercurous sulphate with powdered crystals of cadmium sulphate and a saturated aqueous solution of cadmium sulphate. The different methods of preparing the mercurous sulphate paste will be described in notes. One of the methods there specified must be carried out. For setting up the cell, the *H* form is the most suitable. The leads passing through glass to the electrodes must be of platinum wire, which must not be allowed to come into contact with the electrolyte. The amalgam is placed in one limb, the mercury in the other. The depolariser is placed above the mercury and a layer of cadmium sulphate crystals is introduced into each limb. The entire cell is filled with a saturated solution of cadmium sulphate and then hermetically sealed. The following formula is recommended for the E.M.F. of the cell in terms of the temperature between the limits 0° C. and 40° C.

$$E_t = E_{20} - 0.0000406\ (t - 20°) - 0.00000095\ (t - 20°)^2 + 0.00000001\ (t - 20)^3$$

The Conference recommended that the various governments interested should establish a permanent International Commission for Electrical Standards. A Committee of 15 was appointed to serve as advisors on the organization of a permanent commission, and, pending such organization, to formulate plans for such work as may be necessary in maintaining and comparing standards, fixing values and completing the work of this Conference. It was recommended that laboratories properly equipped for precise work should be asked to cooperate with this committee. The committee was also directed to consider the question of enlarging the International Conference of Weights and Measures to include the Conference of Electrical Units and Standards.

We are indebted, in preparing this brief summary of the work of these two international bodies, to the much longer accounts in (London) "Electrical Engineering" of Oct. 15 and 29 and "Electrician" of Oct. 23 and 30.

To distribute the load of the piers either side of the openings to the entire foundation, steel sills have been put under the openings. They comprise at each opening seven 10-in. 20-lb. I-beams 21 ft. long, embedded 12 ins. below the top of concrete.

The sides of the flue openings are protected by an extension of the lining.

ERECTION.

FOUNDATION.—The foundation was built by the owners themselves, with the supervision of an engineer of the contractor for the chimney. It consists of 1:3:5 slag concrete. Both sand and stone were obtained from the smelter furnaces. They were brought to a group of temporary bins by the side of the foundation pit, and a mixer mounted directly under the bins discharged the concrete through a chute down to the work, or into skips. A derrick with 50-ft. boom was set in the center of the foundation, on the unexcavated core, and handled the concrete from the mixer to all parts of the circle.

The foundation consumed 5,200 bbls. cement, 2,000 cu. yds. sand and 4,000 cu. yds. smelter slag. Its total cost was not far from $50,000. It was constructed during 1907, the contract for the entire stack having been signed late in 1906.

BRICKMAKING PLANT.—During 1907 also the chimney contractor was engaged in putting up a brickmaking plant on the ground and producing bricks in preparation for erection. Some 23,000 tons of brick were required. A plant of capacity of 100 tons per day was installed (see Fig. 5). The company describes it as follows:

> The plant was installed to operate with the semi-wet or stiff clay process involving a drying pan crusher, a pug mill, both steam and hot air dryers and nine down-draft kilns. The shale is excavated from the pit at the rear of the plant, by a steam shovel with a 1-yd. dipper and delivered to the latter by dump cars on a narrow gage track which dumps from a trestle on to a pile at the rear of the crusher house. The material is then shoveled to a Freese dry-pan crusher from which it is elevated by a bucket conveyor to a storage bin above the pug mill in the machine room. The pug mill is also a Freese mill in which sufficient water is added to the material for the formation of a stiff clay mixture and from which it is forced through forming dies for shaping the blocks, to the wire cutters. From the latter the green blocks are removed on a conveyor belt and thence transferred by hand to four-wheel steel-frame trucks running on narrow-gage tracks. They are first run into the steam drier in which the special treatment is given to counteract the alkali in the material and thence after partial drying, they are transferred to the hot-air drier for final drying before burning. This mode of treatment was found necessary to prevent checking of the blocks which would otherwise have injured their quality. The kilns are circular domed-roof kilns of the down-draft type and are fired with Montana coal.

The bricks were carried from brick-plant to chimney site by a standard-gage railway spur half a mile long, including a switchback to overcome the considerable difference of elevation. They were piled around the base of the chimney ready to be hoisted up to the work as required.

The erection scaffolding, carried up inside the chimney as the brickwork rose, is shown in plan by Fig. 9. Twelve main posts, 10 × 10-in., braced together and to the brickwork, support working platforms and contain guides for four 6 × 6-ft. elevators. The main posts were made in 16-ft. lengths, doweled together and spliced with cover straps of 2 × 10 plank bolted through. Over 200 M-ft. lumber were used in the scaffolding. Three electrically operated drum hoists and one steam-driven hoist worked the elevators.

The progress of the masonry is exhibited typically by Figs. 10-12, three views of the stack in different stages. The dates of commencement and completion, April 7 and Oct. 23, 1908, show that the whole work was done in a period of 200 days, or 169 working days, making an average of practically 3 ft. of height laid per day. This does not include the lining, which is being put in at present, being started at three or four levels simultaneously.

The stack above foundation required 13,000 tons radial blocks, 3,075 bbls. cement, 5,225 bbls. lime, 4,180 cu. yds. sand and 200 tons acid-proof mortar. It cost about $200,000; in this sum, however, the entire first cost of the brickmaking plant is included, which plant will be left there and operated to supply material for the great dust-chamber and flue and for other construction work around the smelter plant.

DUST-CHAMBER AND FLUE.

The flue gases carry considerable quantities of metalliferous dust, which is valuable and must be collected for recovery. A dust settling chamber is provided in the flue for this purpose. The chamber of the old flues, as also these flues themselves, had been far outgrown by the extension of the smelter. The new chimney will be fed by a new flue, and in this is a dust-chamber many times greater than the old one, as an inspection of Fig. 14 demonstrates. This chamber is a widened part of the flue in which is hung a close array of iron straps to catch the dust in the gases. It is fitted with a continuous series of floor-hoppers, beneath which is a basement with tracks, in which cars are to be run along underneath the hoppers so that the accumulated dust may be discharged directly into the cars. The dust chamber is 176 ft. wide by 478 ft. long, with a clear height of 21 ft. (the same as the height of the flue). The basement story is 12 ft. high.

The flue has rectangular cross-section, 33 × 21 ft. in the part between smelter and chamber, and 48 × 21 ft. between chamber and stack. Near the stack it divides into two branches which curve around and join the flue-openings in the base of the stack. Its profile is fully shown in Fig. 14.

Both flue and chamber are framed in brick, with steel columns (interior and wall) and plate-girder beams, and walls and roof of perforated brick arches. In the walls the flanges of the columns are exposed both inside and outside. The roof beams are also exposed on the inside, but on the outside they are protected by a thick covering of concrete laid over the brick arches. The purpose of this covering is to make the roof weather-proof, so that no moisture can get into the flue. The dry gases are not corrosive to the metal.

The steel frame has transverse expansion joints about every 90 ft., formed by a bulged plate covering an expansion space between the flue ends. These expansion membranes are of sheet steel, the pieces of adjoining sections. The outer surface of these expansion membranes is left exposed. Expansion is provided for in the walls by a grooved joint in the brickwork.

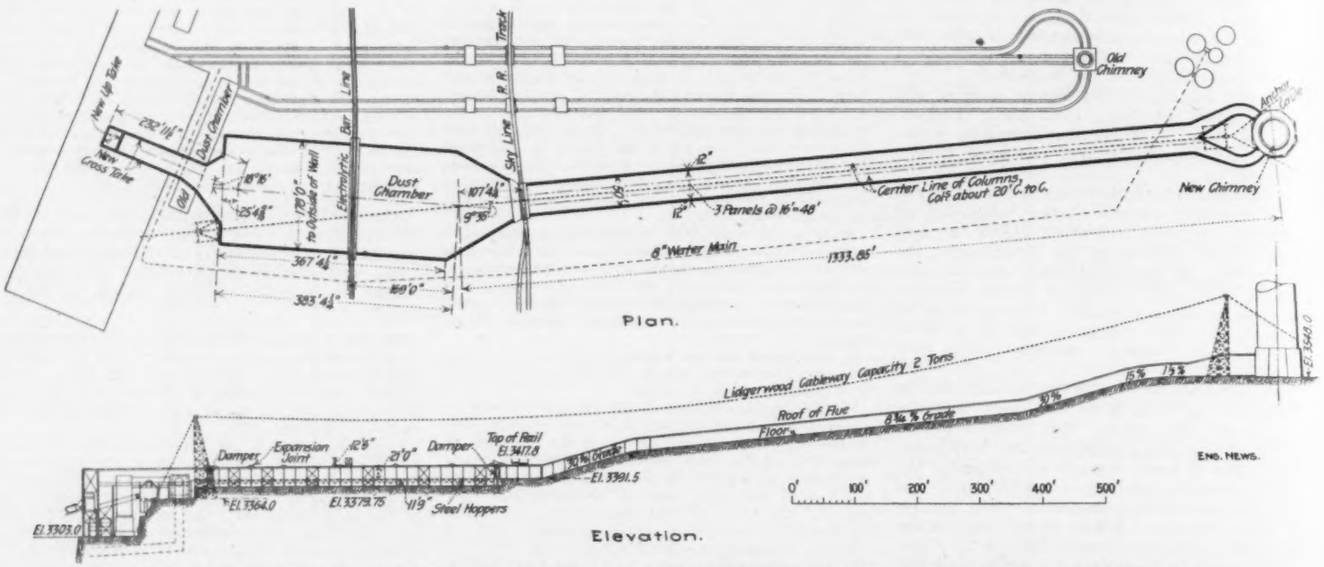

FIG. 14. LOCATION PLAN AND PROFILE OF FLUE AND DUST-SETTLING CHAMBER BETWEEN SMELTER AND CHIMNEY.

The flue and dust-chamber were designed by the Boston & Montana Consolidated Copper & Silver Mining Co. The steel was built by the Jones & Laughlin Steel Co., of Pittsburg, and the brickwork is to be built by the Alphons Custodis Chimney Construction Co., of New York.

AN ELECTRIC FERRY BOAT on the Rhine is described with illustrations in the London "Electrical Engineering," Oct. 8. This boat provides regular service between Godesberg and Niederdollendorf and is licensed to carry 645 persons. There is free space on a wooden fore-deck to accommodate four harnessed vehicles. The hull is of steel with these compartments between bow and stern: collision space, cabin with bunks for crew, battery room and machine and store room. The bow and low fore decks occupy about two-thirds of the upperworks and on the rear third is the deck house. The back part of this is fitted as a saloon and the front as a navigating cabin. From this latter division which is higher than the saloon and somewhat like a pilot house a free outlook is obtained in all directions. The helm, the motor controls and the electricity-measuring instruments are, of course, in the navigating cabin.

The boat is propelled by two screws each driven by an open frame, interpole, 300-volt, 50-HP. motor at 300 r. p. m. The screws may be controlled separately or together. The battery, located below deck, consists of 160 storage cells in vulcanite cases and has a capacity of 335 amp.-hrs. on a 1-hr. discharge rate, the pressure being about 290 to 300 volts. The battery room is ventilated by portholes and outlet pipes. Two 3-HP. motors operate landing gangways. The batteries are charged on the Godesburg side of the river through a flexible cable which is carried aboard to a plug contact. The landing stage consists of a pontoon, 52 ft. 6 ins. by 16 ft. 5 ins., connecting to the shore by a bridge 82 ft. long. The boat evidently makes fast along side the pontoon and vehicles drive across the decks.

Fig. 12. About 240 Ft. Above Ground, July 23, 1908.

Fig. 11. About 50 Ft. Above Ground, May 14, 1903.

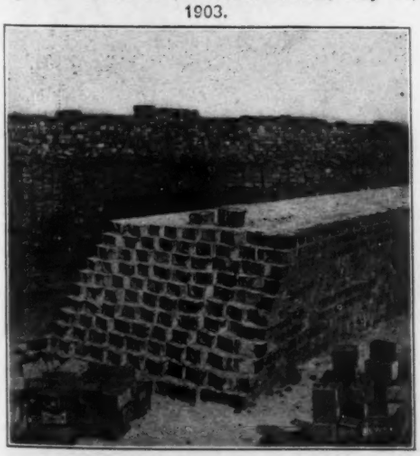

Fig. 10. The Octagonal Base Started, April 10, 1908.

Figs. 10-12. Three Views During the Construction of the 506-Ft. Chimney, Boston & Montana Consolidated Copper & Silver Mining Co., at Great Falls, Mont.

used for chimney construction. (See Eng. News, Nov. 21, 1901, p. 398.) Five sizes were used, all being 4⅝ ins. thick and 6¼ to 6¹¹⁄₁₆ ins. wide at butt, with the following lengths: 4 ins., 5 ins., 7⅛ ins., 8⅝ ins., and 10⅝ ins., which permit thorough bonding in radial direction.

The mortar was 1:2:5 cement-lime-sand mortar. For a distance of 50 ft. below the top, the outer surfaces of the brickwork were pointed up with acid-proof mortar.

At the junction of the octagonal base with the circular barrel, the horizontal ledge of the brickwork of the base is capped with a steeply sloped filling of concrete, as rain protection. This is the more necessary as the large quantities of rain water which may drain down along the outer surface of the chimney must be turned here, without the possibility of water percolating down into the brickwork of the base.

LINING.—The lining is simply a 4-in wall of acid-proof brick, with vertical perforations like the brick of the chimney body, resting on corbel rings on the inner face of the chimney wall as already described, and laid up so as to leave a 2-in. air-space between wall and lining. It is laid in "acid-proof mortar," a white composition of silicate of soda, asbestos wool and other ingredients, which is said to be proof against the attack of any acid and against temperatures of 2,000° F. The heights of the sections of lining are kept down to 20 ft. A new section of lining is started at the base of each section of chimney wall, and where the latter is more than 20 ft. high an intermediate corbel is also provided, making two (in some cases three) lining sections for the one wall section.

The joint between the top of one lining section and the bottom of the next is detailed as shown by sketch in Fig. 6, the entire interior face being acid-proof brick. The aim was to get as nearly tight a joint as possible, to prevent access of gases, dust, etc., behind the lining. To this end, also, a packing of mineral wool was put the into the space at the top of the lining.

There are no vent-holes through the outside wall to the air-space.

CAP AND OTHER TOP PROTECTION.—The top of the chimney is corbeled out, in steps of ¾-in., to a thickness of 42 ins., from the 18-in. wall thickness of the top section. The upper surface is sloped down from the inner edge to outer edge 4 ins. to the foot. It is covered with specially shaped radial interlocking terra-cotta tiles laid solid in acid-proof cement and pointed up with the same material (see Fig. 8). These have separate T-shaped joint-capping tile. The upper 3 ft. part of the brickwork of the chimney wall is also laid in acid-proof mortar.

LIGHTNING PROTECTION.—Sixteen lightning-rods project 5 ft. above the chimney top. They are of 1-in. round copper rod, lead coated for protection against acid and tipped with a platinum point 1¼ ins. high. They are all connected to a horizontal copper ring encircling the stack a few feet below the top, and from this ring two ⅝-in. copper cables lead to the ground. All of this metal-work, down to a point 100 ft. below the top, is coated with an ⅛-in. thickness of lead for protection against acid, and where two pieces cross or connect their coatings are sweated together to make a continuous covering. The bottom ends of the two leader cables terminate at copper ground-plates 3 ft. square, buried some distance away from the chimney foundation.

LADDER.—An outside ladder extending from the base to cap was built in the brickwork. It consists of one-piece rungs of ¾-in. round iron, 12 ins. wire, and one-piece guard loops of the same material, 30 ins. wide. The rungs are 6 ins. clear from the wall, and the guard loops are 18 ins. out from the rungs. Guard loops are at alternate rungs. Both guards and rungs are lead-coated for the upper 100 ft., and painted below this.

DRAINAGE.—To take care of the drainage from the outer surface of the stack required special attention in this chimney because of its enormous exposed surface, and the large volume of water which might run off from it in a heavy driving rain. Rainfall and condensation inside the chimney also required suitable provision.

The outer drainage was provided for by a large gutter molded in the top of the concrete foundation, extending all the way around the stack and discharging by two concrete spouts. This gutter is semicircular, 30 ins. wide by 12 ins. deep near the gutter, sloping down toward this point ⅛-in. per ft. The photograph Fig. 4 and the drawing Fig. 6 show it completely.

Inside an acid-proof pavement pitched to a drain-pipe was provided. The pavement comprises a 6-in. concrete foundation, 4 ins. of sand, and a layer of acid-proof brick laid in acid-proof mortar. It is pitched ½-in. per ft. toward the center, where the bricks are laid to form an 8-in. drainage opening leading to a 6-in. vitrified tile duct. The opening in the floor is covered with a lead screen.

REINFORCEMENT OF FLUE OPENINGS.—The octagonal base contains four openings 15 ft.

Fig. 13. The Completed Chimney.
(The white appearance of the upper 50 ft. is due to the pointing with special acid-proof mortar.)

wide by 36 ft. high for connecting the flues leading from the smelter plant. An I-beam lintel carries the brickwork over each of these; it consists of seven 9-in. 21-lb. I-beams 19 ft. long, resting at either end on a 24 × 1-in. steel bearing plate 7 ft. long. Specially shaped bricks set in acid-proof mortar enclose the lower flanges of the beams as protection from the heat and the corrosive action of the flue gases.

Arches in such a location as the top of the flue opening do not prove satisfactory, in the experience of designers of this chimney, at least when over 6 to 8 ft. in span. Even though they are only false or fascia arches, cracking outward from the skew-back is bound to develop sooner or later.

For the first, only two of the flue openings are to be used (see plan of flue, Fig. 14), and the idle openings are bricked up with 15-in. walls containing 2 × 3-ft. cleanout doors through which the metalliferous dust accumulating in the stack may be removed.

foundation block begun. Fig. 7 gives its dimensions. As will be seen it is an annular mass, with circular inner edge 47 ft. in diameter at the bottom and octagonal outer boundary 103 ft. across flats at the footing level, tapering to 10 ft., except in the octagonal base, and the greatest 50 ft., as shown by Fig. 6 and in the table of loads and stresses, below.

A heat protecting lining 4 ins. thick extends from bottom to top of the stack. It is of the

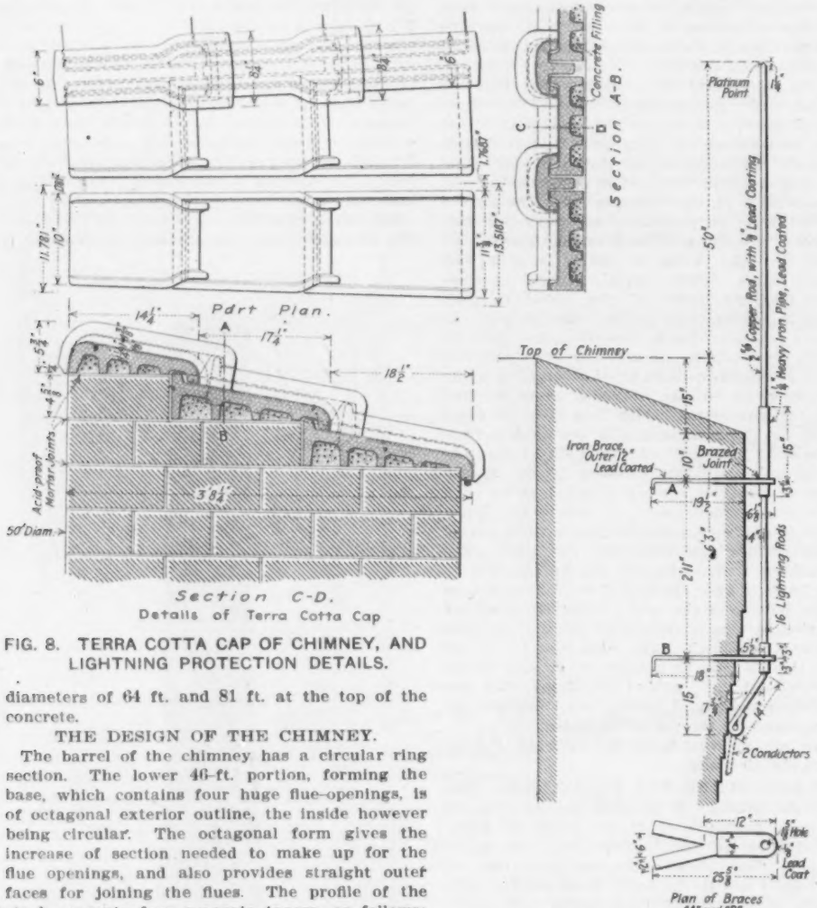

FIG. 8. TERRA COTTA CAP OF CHIMNEY, AND LIGHTNING PROTECTION DETAILS.

diameters of 64 ft. and 81 ft. at the top of the concrete.

THE DESIGN OF THE CHIMNEY.

The barrel of the chimney has a circular ring section. The lower 46-ft. portion, forming the base, which contains four huge flue-openings, is of octagonal exterior outline, the inside however being circular. The octagonal form gives the increase of section needed to make up for the flue openings, and also provides straight outer faces for joining the flues. The profile of the stack presents four separate tapers, as follows: the upper 180 ft. 1% batter (or a taper of 2% measured on the diameters); the 100 ft. next below, 2% batter (4% taper); the next 180 ft., 3½% batter (7% taper); and the octagonal base, 4% batter (8% taper). These tapers, in conjunction with increasing thickness of wall in steps of 2 ins., gave the required increase of strength from top to bottom in due proportion to maintain the maximum compression below a fixed limit.

The height of section having constant wall-thickness is of course variable, the lowest being now well-known sectional construction, in which the chimney wall is corbeled inward at intervals not exceeding about 20 ft. and the lining is sectionalized correspondingly, each section, resting on its corbel, being independent of the remainder of the lining. This lining increases the moment of stability against wind-pressure at every section (which would not be the case if it were supported only at the bottom), though, of course, it does not add to the effective cross-section in the matter of strength.

The determination of the wall-thicknesses proceeded by analysis of stresses from the top downward, exactly as in the case of a dam, for example. The thickness at top (18 ins.) was fixed arbitrarily, except in so far as it was determined by the requirement of supporting a future addition of 60 ft. At a section a given distance below the top, assuming the wall thickness constant, and the external profile being selected beforehand, the weight of brickwork above this level is computed, and the pressure per square foot due to this weight is then found by dividing by the area of section. The total wind pressure above the section and its overturning moment are next computed, and the moment divided by the section modulus of the cross-section under consideration gives the unit-stress due to wind. If this wind stress is less than the pressure from weight the maximum pressure (leeward edge) is obtained by adding the wind stress to the weight stress, and the minimum pressure (windward edge) by subtracting the wind stress from the weight stress. If the maximum pressure exceeds the limiting safe stress allowed in the brickwork, the thickness must be increased at a point above this section, the height of this point being such that the allowed limit of pressure is just reached at its windward edge. This point of change of section may be determined either by several trial computations, as by calculating stresses at short intervals from the top downward, say 5 ft. or 1 ft., depending upon the rapidity of increase of stress, or it may be determined by putting the stress calculation into algebraic form, with the height below the top as unknown quantity, and solving the resulting quadratic equation. In either case the details of the method will be self-evident, and the preceding explanation is given only to explain the table below, in which are entered the essential quantities of the calculation for each of the 23 sections of change of thickness in the barrel of the chimney, and for the footing level (section 24).

The limit of pressure in the brickwork was fixed beforehand at 21 tons per sq. ft. (290 lbs. per sq. in.) for the present height, and 22 tons per sq. ft. (305 lbs. per sq. in.) for the contemplated future increase of height by 60 ft. Bricks of the kind used here (hard-burned perforated brick for chimney work have previously given ultimate crushing strengths in laboratory tests (by Prof. I. A. Woolson) up to 6,000 lbs. per sq. in. gross section, or about 400 tons per sq. ft. As will be seen from the table, the actual stresses for the wall thicknesses shown in Fig. 6, exceed the limit of 21 tons by less than 2%. At the same time the stress on the windward side is never reduced to the point of incipient tension, and in fact the wind stress in the worst case is less than one-half the dead-load.

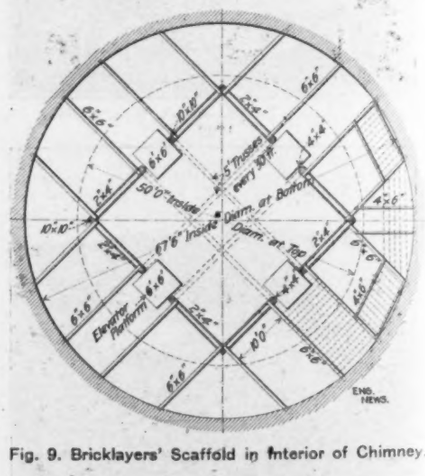

Fig. 9. Bricklayers' Scaffold in Interior of Chimney.

RESULTS OF CALCULATIONS FOR 506 FT. CHIMNEY AT GREAT FALLS, MONTANA.

Outside diameter: at base, 78 ft. 6 ins.; at top, 53 ft. 9 ins. (end of corbeled cap enlargement). Inside diameter (excl. lining and air space): at base, 66 ft. 6 ins.; at top, 50 ft. 9 ins. (50 inside terra-cotta cap).

Number of section.	Thickness of wall, ins.	Height of section, ft.	Total from top, ft.	Weight above section, tons.	Wind pressure above section, lbs.	Wind moment at section, ft. tons.	Cross-section area of brickwork, sq. ft.	Section modulus ft.³	Total bearing pressure—Lee tons/ft.²	Lee lbs./in.²	Windward tons/ft.²	Windward lbs./in.²
1	18¼	50	50	725	90,450	1,127	252.06	3274.83	3.21	45	2.53	35
2	20⅜	50	100	1,693	182,575	4,536	284.72	3740.03	7.16	99	4.74	66
3	22	40	140	2,574	257,475	8,936	315.54	4183.48	10.30	143	6.02	84
4	24	40	180	3,499	333,435	14,843	347.90	4655.18	13.25	184	6.87	95
5	26	35	215	4,396	401,183	21,268	385.0	5256.74	15.49	215	7.39	103
6	28	35	250	5,356	470,565	28,893	424.26	5907.32	17.51	243	7.73	107
7	30	30	280	6,263	531,335	36,405	462.36	6541.10	19.11	266	7.99	111
8	32	30	310	7,229	593,755	44,840	500.08	7432.63	20.23	281	8.17	113
9	34	20	330	7,961	636,535	50,990	552.51	8213.94	20.61	286	8.21	114
10	36	20	350	8,711	680,248	57,567	596.31	9028.47	20.99	292	8.23	114
11	38	15	365	9,329	713,645	62,794	637.8	9776.42	21.04	292	8.20	114
12	40	15	380	9,966	747,567	68,273	681.39	10568.55	21.08	293	8.16	113
13	42	13	393	10,558	777,391	73,229	723.29	11328.48	21.05	292	8.12	113
14	44	13	406	11,175	807,900	78,380	765.96	12113.55	21.06	293	8.12	113
15	46	13	419	11,825	838,222	83,728	810.40	12938.26	21.06	293	8.12	113
16	48	11	430	12,410	864,433	88,410	852.88	13716.82	20.99	292	8.11	113
17	50	10	440	12,964	888,506	92,792	895.06	14485.40	20.89	290	8.07	112
18	52	10	450	13,539	912,813	97,296	938.82	15286.18	20.78	288	8.06	112
19	54	10	460	14,140	937,353	101,921	982.11	16090.52	20.83	289	8.17	113
20	60*	16	476	15,304	980,214	109,591	1065.87	17398.99	20.66	287	8.06	112
21	62*	15	491	16,312	1,021,057	117,095	1117.23	18480.58	20.94	291	8.26	115
22	64*	8	499	16,884	1,043,101	121,223	1158.30	19257.38	20.87	290	8.29	115
23	66*	7	506	17,404	1,062,539	124,908	1196.34	19962.12	20.81	289	8.29	115
Footing: 24	336*	22½	528½	24,964	0	136,862	7053.56	106173.0	4.83	67	2.25	31

*In octagonal part; thickness given is at flats.

DETAILS OF CONSTRUCTION.

BRICK WALL CONSTRUCTION.—The brick used for the main chimney wall is the vertically perforated radial style of brick widely

fore specified that provision was to be made for gales up to 125 mi. per hr., and in the course of the design this clause was translated into the following terms: Effective pressure against cylindrical (really conical) surfaces of barrel, 33⅓ lbs. per sq. ft. diametral projection; effective pressure against octagonal base portion, 35½ lbs. per sq. ft. diametral projection in plane of parallel sides.

The contract made with the chimney construction company was contingent on the possibility of producing satisfactory brick from the material found at the site. A strong and fairly uniform shale forms the body of the plateau, hard rock occurring only at a considerable depth, near the level of the valley bottom. This shale was thoroughly studied, chemically and by making test bricks of it, with the final conclusion that it was entirely suitable for the purpose. Thereupon a brickmaking plant was built on the ground, near the chimney site. Shale was excavated by steam-shovel from a pit not far away, and except for a small admixture of fire-clay brought in by railway from a point 12 mi. away, it formed the material for the entire stack. Selected portions of the shale made the special heat-resisting and acid-proof brick of the 4-in. inner lining.

As concerns a foundation, no hesitancy was felt in deciding that the shale would be quite sufficient for carrying the 17,000 to 18,000 tons weight of the stack. The first plans were for carrying an excavation down 30 ft. and building a concrete spread footing up from this level, with a maximum pressure (at lee edge, from load plus wind) not exceeding 5 tons per sq. ft. But as the excavation went on the shale showed up so uniform that no particular advantage was to be expected by going to 30 ft., and at 20 ft., therefore, a load test was made to determine whether the bearing power at that level was sufficient. Four cast-iron bed-plates, each 2 ft. square, were loaded with rails to the total amount of 208,935 lbs., which load was left on for about a month. The slight initial depression under this load did not increase throughout the test period, from which it was concluded that the load was well within the limit of stability. This loading amounted to 6½ tons per sq. ft., whereas the maximum pressure at lee edge, if the foundation were terminated at about this level, would be slightly below 5 tons per sq. ft.

The excavation was therefore terminated at 22½ ft. below ground surface, and the concrete

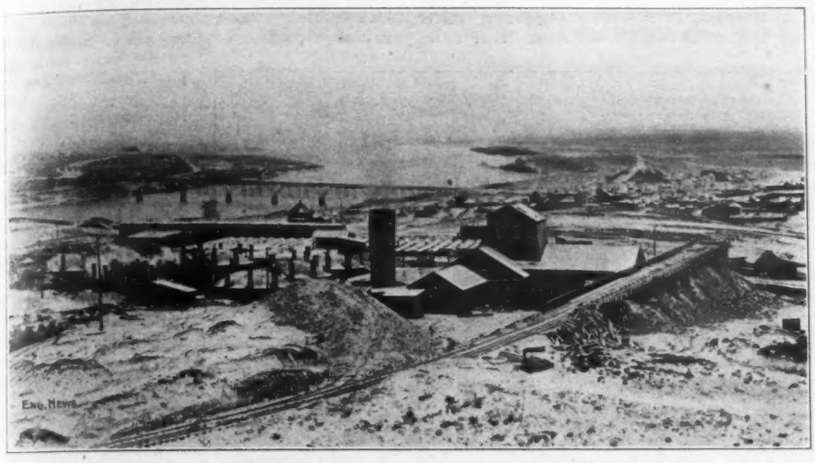

FIG. 5. THE BRICK-MAKING PLANT.

(This plant was built specially for supplying the hard-burned radial perforated blocks of which the chimney is built. It is only a few hundred feet from the site of the stack, and uses shale excavated near-by. It comprises a steam drying kiln, a large air drying kiln, and eight down-draft burning kilns.

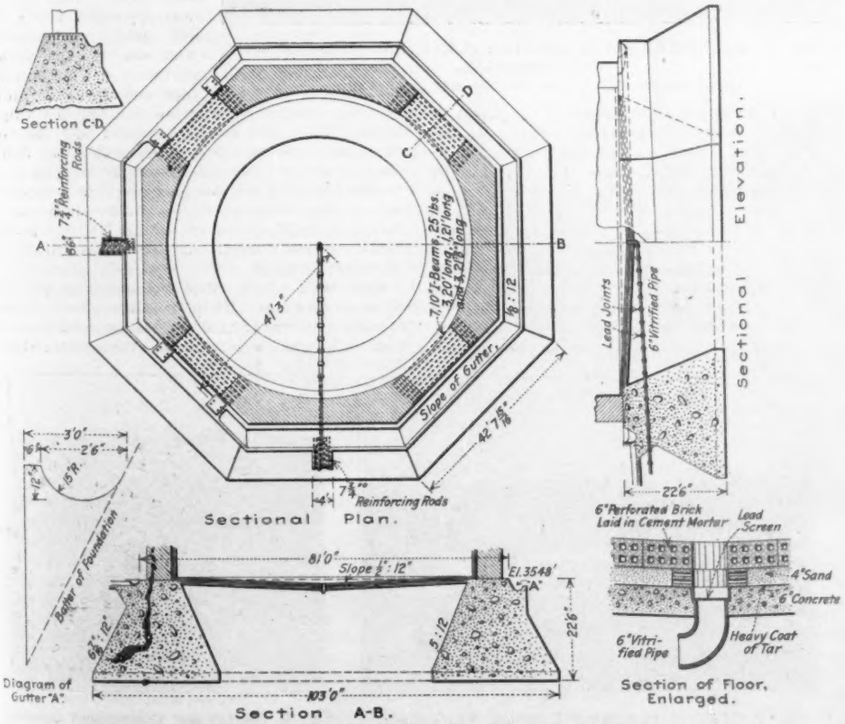

FIG. 7. DETAILS OF CONCRETE FOUNDATION, GREAT FALLS CHIMNEY.

(The pavement, resting on the earth core inside the foundation ring, is made of acid-proof brick.)

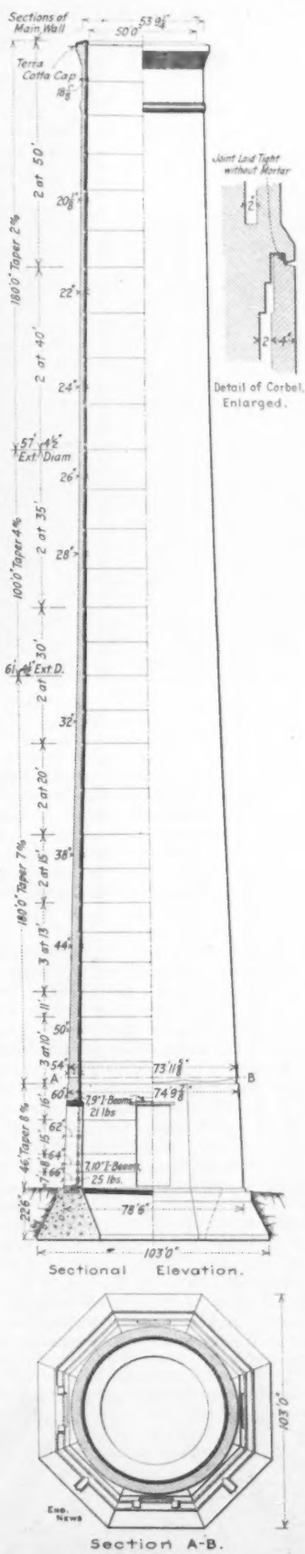

Fig. 6. General Drawing of 50-Ft. x 506-Ft. Chimney for Boston & Montana Consolidated Copper & Silver Mining Co., at Great Falls, Mont.

finds that his mental caliber is greater than he expected, there is always the technical college. The trade school ought not to be used as a fitting school for these colleges, but it ought to serve as a weeding-out school in the reverse sense to that usually used. That is, out of the large number of applicants which such a school will be sure to have, it should be possible to find a reasonable number capable of making good machinists, many capable of becoming exceptionally fine workmen and a few capable of developing into foremen, superintendents and engineers. Leaving aside all question of whether the best engineer is shop made or school made, it would seem to be the province of a trade school to keep itself clear of all technical school leanings and affiliations since otherwise there is danger of trying two experiments at once, and hence not being able to tell which is the success.

It is to be hoped that if this school is started in Worcester it may expand until it offers courses in many other trades. For unless a municipality intends to offer equal advantages to young people for all the trades that are largely practiced therein, it has no logical basis for offering advantages to any; and unless equal facilities are offered in many trades, there must necessarily result an overcrowding of the few for the reason that many boys will become students merely because they consider that it will pay and not because they themselves have any special liking or fitness for those particular trades. The plan of the school is broad enough to cover all the trades which are fully practiced in Worcester, and if the results of the canvass of the city made by the State Commission are dependable, there are some 2,500 or more children whose parents would prefer to send them to some school of the kind suggested by the commission rather than to the regular high school. This number is in excess of the number now enrolled in the high schools of the city. The plan proposed in Fitchburg would not be applicable to many trades, particularly those whose practice is dependent on the weather, and in many others it would not be easy of application.

As to the putting of boys to work steadily, the Worcester plan involves the securing of the boy's time for eight hours per day for eleven months in the year. The schedule of shop and studies, however, shows that of this time only about half is to be devoted to shop work, and of the balance a considerable part is allowed for study which may be done evenings, thus leaving a considerable amount of time for play by daylight. By calling for a definite amount of time it will be possible to better regulate sports than can be done in college, where faculties usually claim that they are not responsible for the acts of students out of school hours. I understand that during the heated term it is proposed to reduce the class room studies in favor of recreation. The control of the student's time will not be in the hands of men interested in them from a profit-making standpoint, which makes it more certain that their general health and mental condition will be carefully watched.

THE WORLD'S LARGEST CHIMNEY: 50 × 506-FT. BRICK STACK FOR THE BOSTON & MONTANA SMELTER AT GREAT FALLS, MONT.

On Oct. 23, 1908, a chimney of unprecedented size was topped out. This is a stack 506 ft. high above top of foundation ring and 50 ft. in interior diameter at top, at the smelter plant of the Boston & Montana Consolidated Copper & Silver Mining Co., about three miles from Great Falls, Mont. It is not only the highest in the world by some 40 ft., and the highest in America by 140 ft. (Eastman Kodak Co. chimney 366 ft., Orford Copper Co. chimney 365 ft.), but also by far the largest in capacity. With a draft of 3¾ ins. water (expected with gases at 600° F. average) its great diameter will give a discharge capacity of 4,000,000 cu. ft. of gases per min.

This chimney stands at a base elevation of 3,549 ft. above sea-level, so that its top is 4,055 ft. in elevation. The Alphons Custodis Chimney Construction Co., of New York City, designed and built it. The first brick was laid on the finished concrete foundation on [illegible] 7, 1908, and on Oct. 23 the shell was completed. Work is now in progress on the interior heat-protective lining and the large flue, 2,000 ft. [illegible] ing, for conducting the gases from the smelter to the chimney.

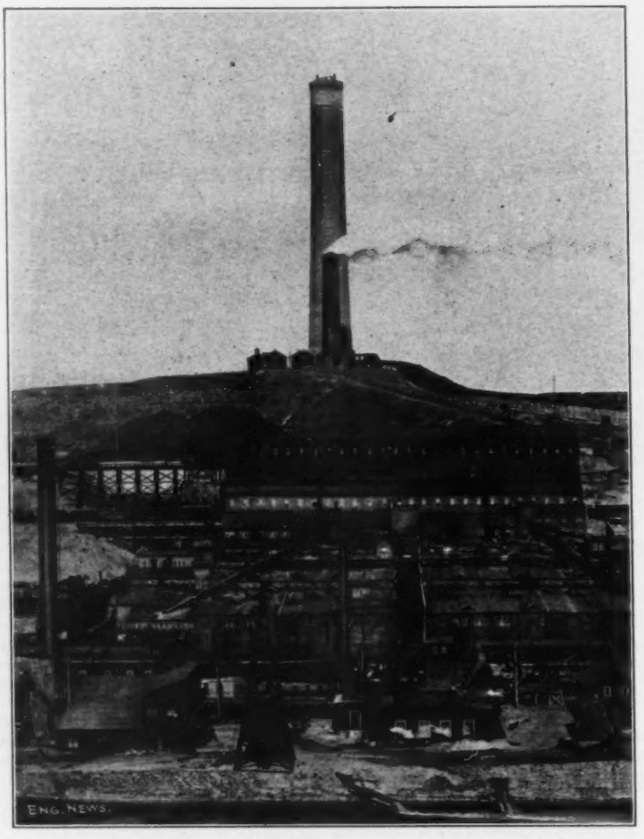

FIG. 1. THE GREAT FALLS SMELTER PLANT, AND THE OLD AND NEW CHIMNEYS.
(By telephoto view across the Missouri River Valley.)

REQUIREMENTS.—The existing stack, [illegible] ft. high, has insufficient capacity for the needs of the smelter. The plant, with its most recent extensions, when working at its maximum capacity, may produce as much as 2,000,000 cu. ft. of gas per min. (about three times the discharging power of the old stack), and with a view to growth a chimney of double this capacity was desired.

The old chimney had suffered severely from the corrosive action of the acid gases, and the new chimney was therefore required to be proof against the action of acids. The smelter gases contain much sulphur dioxide, and while when dry the gases do not act even on exposed steel, when moisture is present sulphurous and sulphuric acid form, which attack even the ordinary brick. Careful selection of materials, however, makes possible the production of bricks proof against acid corrosion.

A height of 500 ft. above the general level of the upland on which the old chimney stands was selected as the desired height of the new stack; this was equivalent to 506 ft. above base of brickwork, at the particular point chosen for the structure. The height was governed solely by the draft requirements, and not by the desideratum of discharging high enough in the air to prevent creation of a nuisance; for, the valley bottom being 250 to 300 ft. lower and the city of Great Falls some 500 ft. lower than the tableland, even the old stack had discharged at a height sufficient for this purpose. The new stack was to be designed for a future increase of height of 60 ft. above the initial 506 ft., so that a still stronger draft may be secured if found necessary later on.

Very high winds occur frequently at the site of this chimney. Their possible effect on the structure is augmented by its exposed location and its height above ground. The owners there-

Fig. 2. Foundation Pit.
(Frames for concrete forms in position.)

Fig. 3. Top of Completed Concrete Foundation.
(Inside diameter of concrete at top, 64 ft. Outside octagonal, 81 ft. across flats.)

Fig. 4. Gutter and Drain-Spout Outside of Chimney Foundation.
(A 30-in. gutter, 12 ins. deep, is molded in the concrete along the outer edge of the foundation to carry off the large quantities of water which may run down the face of the stack in a driving rain.)

FIGS. 2 TO 4. THE FOUNDATION OF THE 506-FT. GREAT FALLS CHIMNEY.

school, and one which shall be largely Not that the shop is everything, but that st training for life is life, and to train a or shop life in anything but a shop is like him to learn to swim without water. hop is to be the center from which all in- ion radiates. Mathematics is to be the point of the school room work. Arith- is to be reviewed with especial care to problems from shop work which shall have inclined to detest the more scholastic studies, and who would probably not be attracted by the studies recommended except as they are made to appear necessary and closely related to their shop work.

In the drafting room and shop it is the desire of the commission that a commercial, shop atmosphere shall be approximated with a thorough teaching of the principles underlying the trade. So far as possible "exercises" are to be the relation of parts and acquiring judgment as to the necessity of polishing this part or another and of the degree of nicety of fits required. Under the head of shop lectures, for which from two to five hours per week is allowed in the report of the commission, there is opportunity for instruction in such things as can be told by word of mouth better than by shop operation sheets or by individual help, and also for shop inspection about the city. The work in

FIG. 8. PORTAL OF TUNNEL IN GRANITE.

FIG. 9. THE OPEN CANAL DURING CONSTRUCTION.
[Excavation completed; track being laid for concreting.]

a technical value in addition to their value in pure mathematics. The boys will be taught the computation of gear ratios, change gears, set-over for tapers, etc., and the arithmetic necessary for use in cost and bookkeeping, including percentage and interest. Algebra, geometry and simple triangles under trigonometry will be treated in the same way as subjects whose value for mental training is not belittled. Physics is scheduled to be carried through nearly the whole course, and, as I understand it, is to be begun in a very simple way, covering the whole range by picking out parts easily understandable by a boy of 14 or 15, and working more and more into the mechanics of framework and machinery, nowhere approaching technical college work in mechanics or mathematical physics, but gradually impressing the student with the power of the laws of nature and with his own power if he will work in harmony with them. The practical side of physics will be illustrated by the use of the shop instead of a laboratory, abundant opportunity being there found for examples of the application of such laws as are of use to the workman in his daily tasks and in his future development.

The study of English accompanied by work in civics the first two years, history the second and political economy the third, is to consist of careful work in written and oral expression and the reading and study of the best of literature both technical and non-technical. This is the work which is to be depended on to broaden the student's mind both from a scholastic point of view by reading the fiction of the masters and from a technical viewpoint by reading such technical literature as the student may be able to comprehend, to the end that he may thereby realize the broad value of his trade and not narrowly imagine that all outsiders are barbarians. This course will comprise practically all that is included in the plan that will be purely scholastic, all the other class-room work being so closely interwoven with the shop work as to be more purely technical than the names may imply. To the writer's mind the fact that these subjects are to be so interwoven does not in any way decrease their value from the educational point of view. He believes that a young man may learn to think just as well over a problem in mechanics or physics as over Latin or Greek, and in fact better, because the students who would be attracted by a trade school necessarily will belong largely to the class who are avoided as such, and for them will be substituted the making of commercial products or parts of machines which may be made to involve as close, careful work as it is wise for the student to attempt and which may, at the same time, be of such nature that even the unsuccessful work of the student is of practical use. For example, we will suppose that a student is given fifty collar screws of a given size to make. He will be told how such screws can be made economically and then told that he is to make this lot by job-shop methods for the sake of the skill which he may acquire. He will then pick out the right size stock, cut it off, center and square it up and turn the body to size to limit gages or to the micrometer, cut the thread to gages having much less than commercial limits and thus do all the work involved in

Fig. 10. Barrett Dam Site from Below, Jan. 25, 1907, Showing Winter Flow of Cottonwood Creek, San Diego Water Supply.

making the screws under conditions which demand much better work than is necessary to make the product commercially usable. In this way he will gain skill and at the same time will not spoil a large amount of work. After a long enough period spent in doing such work to give him a degree of reliability and confidence he will be put upon the repair of used machinery and the making of new machines, thus learning the blacksmith shop, pattern shop and molding room will follow the same general line.

If we grant the principle referred to in the editorial of Sept. 17 that "there should be taught in school first those things which can be secured elsewhere, or afterwards, not at all or only imperfectly," the question now arises whether the Worcester plan agrees with this principle.

In the school room work it may be suggested that the practical use of arithmetic has always been left to the pupil to pick up by experience. The same may be said of the other work in mathematics. Granted that this has been the case, why not ask how many have picked up the practical part compared with the number who are mentally able to do it? The one great arraignment against the Massachusetts public school system to-day is that it does not teach the useful application of the studies which it professes to offer.

In the shop course it may be said that it would be better to leave the final acquirement of skill, the habit of using tools carefully, till the student became employed on commercial work; to which the writer would reply that in his opinion the boy who is sent out of a school provided only with a training which has taught him how a job ought to be gone at, but not to do it well himself, could not get into the good graces of an employer and get the opportunity of acquiring skill without going through a probationary period quite equal to an ordinary apprenticeship. In modern shop organization there is left no room for the learner except as it is provided for by a training school within the shop. If the shop is small this provision is so expensive as to be out of the question. A city like Worcester, having no great shops can only expect to have trade schools at the public expense. Once beginning, they must follow the line to its logical conclusion and carry the student to the point where he will be acceptable to an employer in a position where what he has learned at the public expense will enable him to work higher without unlearning in the large works what has been taught him in the trade school. Another matter: does the Worcester plan leave out that which might better be a part of the school curriculum? Does it plan to teach all that a young man who expects to be a machinist may reasonably be expected to know? To this last question I would say yes, and more. For the boy who has higher aspirations or who

CONCRETE BLOCK MOLDING MACHINES.—Coltrin-Boos Mfg. Co., 140 West Main St., Jackson, Mich. Paper; 7 × 5¼ ins.; pp. 32; illustrated.

The machines are for bricks and blocks of various designs. Information is given as to the preparation of the concrete and the making of the blocks.

PORTLAND CEMENT.—Peninsular Portland Cement Co., Jackson, Mich. Paper; 4 × 6 ins.; pp. 68; illustrated.

In addition to particulars of "Peninsular" cement, there is general information as to the varied uses of Portland cement for engineering, architectural and decorative work.

CONCRETE MIXERS.—Kingston Mfg. Co., Wilkesbarre, Pa. 6 × 9 ins.; pp. 8; illustrated.

The Hadsee concrete mixer, described in this catalog is a batch-mixer consisting of an octagonal drum built up of eight heavy cast-iron segments riveted together, and two heavy steel plate sides.

STEEL SHEET PILING.—Wemlinger Steel Piling Co., 11 Broadway, New York. Large folder; illustrated.

The Wemlinger steel sheet piling, advocated by this folder, consists of long piece of longitudinally curved iron plates, somewhat like corrugated iron, which can be driven in either single or double lap.

WHEELBARROWS.—The Toledo Wheelbarrow Co., Toledo, O. Paper; 6 × 9½ ins.; pp. 44; illustrated.

Steel and wooden wheelbarrows for contractors' use and special purposes are shown in considerable variety. Concrete barrows and dump cars are included. Prices are given in all cases.

STEEL WHEELBARROWS AND TRUCKS.—Archer Iron Works, Chicago. Paper; 7 × 9½ ins.; pp. 8; illustrated.

This is a price list of wheelbarrows of various design, including dump barrows and carts for handling concrete. The trucks and cars are for use in mines, industrial plants, etc., and on contract works.

CONCRETE MIXER.—The Knickerbocker Co., Jackson, Mich. Paper; 3½ × 6 ins.; pp. 16; illustrated.

The Coltrin mixer has a horizontal revolving cylinder fitted with mixing blades. Several portable outfits are shown, driven by belting or by direct connection with an Ideal gasoline engine mounted on the machine.

STEEL WHEELBARROWS AND CARS.—Sterling Wheelbarrow Co., 238 Oregon St., Milwaukee, Wis. Paper folder; 15 × 22 ins.; illustrated.

This shows a variety of concrete barrows and carts, and wheelbarrows for contractors' work. The concrete carriers range from 3½ to 6 cu. yds. capacity. Descriptions are given of the construction and special features.

CEMENT MACHINERY.—Vulcan Iron Works, Wilkesbarre, Pa. 6 × 9 ins.; pp. 23; illustrated.

The title notes that this company carries a complete line of machinery for burning, drying and cooling Portland cement, either wet or dry process and the catalog itself illustrates and describes many of these devices.

VALVES FOR WATER-WORKS.—Globe-Anderson Valve Specialty Co., Fulton Building, Pittsburg, Pa. Paper; 8½ × 11 ins.; pp. 4; illustrated.

The circular gives a brief description of automatic water service valves, float valves, altitude valves and standpipe valves. All of these are cushioned. Steam valves and the Golden tilling steam trap are listed also.

CONCRETE REINFORCING METAL GOODS.—The General Fireproofing Co., Youngstown, Ohio. 3½ × 8 ins.; pp. 24; illustrated.

This is a listed catalog of the various metal goods manufactured by the company comprising metal lath, corner bead, studding, metal furring, wall-ties and concrete reinforcement.

ADJUSTABLE STEEL CENTERS FOR CONCRETE.—Adjustable Steel Centering Co., 71 S. Main St., Fond du Lac, Wis. Paper; two pamphlets; each 3½ × 6¼ ins.; pp. 8; illustrated.

The centering is for sewers, culverts, etc., from 12 to 48 ins. diameter or for egg-shape sections up to 36 × 54 ins. Testimonials are given and illustrations show the centering in use.

CARS, TRUCKS AND BOLSTERS.—Bettendorf Axle Co., Davenport, Ia. Paper; 9½ × 6¼ ins.; pp. 64; illustrated.

Arch-bar or diamond-frame trucks having cast steel side frames and bolsters occupy a considerable part of this pamphlet, and are shown as applied to various types of cars. Other specialties are I-beam bolsters (with the web corrugated to form a fish-belly member); cast-steel fittings for underframes and tank cars with steel underframes.

AIR WASHER.—The Donaldson Co., 7333 Wentworth Ave., Chicago. Paper; 8½ × 11 ins.; pp. 4; illustrated.

The Eclipse air washer and humidifier is a device for use in connection with ventilating plants. The air passes through a spray of water which removes the dust particles, after which the excess of moisture in the air is removed.

CONCRETE MACHINERY.—Waterloo Cement Machinery Co., Waterloo, Ia. Paper; 6 × 3½ ins.; pp. 23; illustrated.

The machinery includes the Polygon drum concrete mixer (in various sizes), the Stewart cement block machine, steel wheelbarrows and the Yale gasoline engine. A special folder deals with the Stewart block machine and the Baldwin portable hand-power concrete mixer.

CEMENT AND CONCRETE MACHINERY.—Cement Machinery Mfg. Co., Columbus, O. Paper; 9 × 12 ins.; pp. 116; illustrated.

This is a catalog and price list of molding machines for blocks of various kinds; also for tile, tanks and cisterns. Concrete mixers and hand tools are listed, together with tampers, cars for handling blocks and other specialties.

CEMENT FOR BUILDING CONSTRUCTION.—Marquette Cement Mfg. Co., Marquette Building, Chicago. Paper; 6 × 9 ins.; pp. 8; illustrated.

This pamphlet shows views of the La Salle Hotel, now being built in Chicago at a cost of some $3,500,000. The Marquette Portland cement is used in the foundation caissons and reinforced-concrete work, about 25,000 barrels being supplied.

WIRELESS TELEGRAPH SETS.—Collins Wireless Telephone Co. Paper; 6 × 9 ins.; pp. 12; illustrated.

This catalog describes several wireless telegraph sets from the simplest boys' instruments to those having syntonic adjustment.

This catalog is accompanied by Vol. I. No. 2, of the "Collins Bulletin," filled with items relating to the company's apparatus and business.

PORTLAND CEMENT.—Peerless Portland Cement Co., Union City, Mich. Paper; 6 × 9 ins.; pp. 71; illustrated.

This pamphlet describes the process of manufacture as employed at the company's works, and gives the results of a number of laboratory tests made by engineers. There are also numerous testimonial letters and views of structures in which Peerless cement has been used.

PLASTIC PORTLAND CEMENT.—Garden City Sand Co., 188 Madison St., Chicago. Paper; 4 × 9 ins.; pp. 40; illustrated.

This is a descriptive pamphlet and price list of "Stonekote" for the finish of buildings, and gives particulars for its application for both exterior and interior finish. It can be applied to stone, brick, concrete or lathing. Views of buildings thus treated are given, together with testimonials.

BAGS AND BAG FILLING MACHINES.—The Urschel-Bates Valve Bag Co., Toledo, O. Paper; 6¼ × 9½ ins.; pp. 20; illustrated.

The bags are for cement, hydrated lime, etc., and are closed by folding, no string being required to secure them. When filled they form flat packages. The filling machines automatically feed, fill and weigh several bags simultaneously. Details are given of the machines and their operation.

ENAMEL CONCRETE BRICK.—The Enamel Concrete Co., Des Moines, Ia. Paper; 5½ × 9 ins.; pp. 30; illustrated.

The bricks are made under heavy pressure in a machine, and have a highly-finished and glassy surface which is an integral part of the brick. The facing material is deposited in the molds before the concrete for the body of the brick, and the mass is then subjected to pressure. The machine makes eight bricks at each stroke.

DAMP-PROOF PAINTS.—Toch Brothers, 320 Fifth Ave., New York, N. Y. Stiff boards; 7 × 10 ins.; pp. 132; illustrated.

These paints are of various kinds, adapted for different kinds of work. Some are for protecting steel and others for concrete. There is a special cement-base paint for steel, and a preparation for mixing with cement to produce waterproof concrete. A large part of the book is devoted to half-tone engravings of bridges, buildings, steamers, etc., in which the company's materials have been used.

PAINT AND VARNISH.—The Lowe Brothers Co., Dayton, O. Paper; three pamphlets; 5 × 9 ins.; pp. 20; 5 × 9 ins.; pp. 14; 4½ × 7 ins.; pp. 43; all illustrated.

The proper methods of painting to be employed for different materials are described in the first pamphlet, which also gives particulars of the company's paints. Protective paint for structural and manufacturing purposes is the subject of the second pamphlet. The third is a catalog of the various paints and varnishes which the company manufactures. With these is a folding sheet of color samples of the Lowe liquid paints.

WHEELBARROWS, DRAG AND WHEEL SCRAPERS, AND CONTRACTORS' DUMP WAGONS AND CARS.—The Kilbourne & Jacobs Mfg. Co., Columbus, O. Paper; two pamphlets; 6 × 9 ins.; pp. 96; 8 × 10½ ins.; pp. 15; both illustrated.

The first is a general catalog of a great variety of wheelbarrows, hand carts, contractors' dump wagons, concrete trucks, etc. Drag and wheeled scrapers and grading plows are included. The second pamphlet is devoted to contractors' railway dump cars, ranging from 1½-yd. four-wheel cars to 16-yd. cars mounted on trucks. These last are built of steel and operated by means of air cylinders.

PULVERIZERS.—American Pulverizer Co., 121 Pine St., St. Louis, Mo. Paper; 7½ × 9 ins.; pp. 32; illustrated.

The "American" pulverizer consists of revolving arms having their ends fitted alternately with pivoted hammers and loose steel rings. These revolve in a casing having a cylindrical bottom, part of which forms a screen for the discharge of material pulverized to the required fineness. The machines are used for stone, cement and various other materials. The pamphlet also describes the company's revolving screens and its air separators for separating and discharging dust from the pulverizer or other disintegrating machinery.

CRUSHING MACHINERY.—George V. Cresson Co., 90 West St., New York City. Catalog No. 5, Aug., 1908. 6 × 9 ins.; pp. 72; illustrated.

The Department of Crushing and Concentrating of the Cresson Co. describes in this catalog all of the latest types of crushing machinery made by that firm, including stationary and portable rock crushers, stone crushers, bins, elevators, revolving screens, plaster crushers, corrugated rolls, magnetic separators, belt separators.

REINFORCED-CONCRETE PIPE.—The Reinforced-Concrete Pipe Co., Jackson, Mich. 9 × 12 ins.; pp. 68; illustrated.

The pipe described in this catalog is of concrete reinforced with circumferential and longitudinal flat steel bands, interlocked with each other, the longitudinal ones protruding from each short length of pipe as constructed so as to join to the next. The pipes are made and laid by the company itself in the trench in short sections.

FIREPROOF CONSTRUCTION.—National Fireproofing Co., Chicago, Commercial Nat. Bank Bldg. 7½ × 10 ins.; pp. 60; illustrated.

The title of this pamphlet is "Long Span Fireproof Construction in Reinforced Terra Cotta Hollow Tile, Portraying the Application of the Newest Methods in Use." It is devoted to illustrations, tables and descriptions of the hollow terra-cotta tile construction for floors, partitions and columns. In contrast to many similar publications its statements, while naturally partisan, show a fairness in this partisanship, which could be emulated with benefit by several other brick, tile and concrete fireproofing publications.

For other Proposal Advertisements see pages 43, 44, 45, 46, 49, of Advertisements and Construction News page 184.

BRIDGE SUPERSTRUCTURE.

THE SANITARY DISTRICT OF CHICAGO.

TO CONTRACTORS.

Sealed proposals, addressed to the Board of Trustees of the Sanitary District of Chicago, and indorsed "Proposals for the Superstructure of the C., M. & St. P. Ry. Bridge," will be received by the Clerk of the said Sanitary District at the offices of the said District, on the fifteenth floor of the American Trust Building, Chicago, Illinois, until 12 M., standard time, on Wednesday, December 2, 1908, and will be publicly opened by the Board of Trustees at a meeting to be held on that day, or the first meeting thereafter.

The work for which said tenders are invited, consists of the fabrication, erection and completion of the superstructure of a railroad bridge at the crossing of the Chicago, Milwaukee & St. Paul Railway over the North Shore Channel of the Sanitary District of Chicago, near Chancellor Street, in the City of Evanston, County of Cook, State of Illinois. Said work is to be comple[illegible] on or before June 1, 1909.

The said work is to [illegible] performed in accordance with plans, [illegible]fications and contract furnished by [illegible] Sanitary District of Chicago, which [illegible]ns, specifications and contract may [illegible] obtained upon application at the said [illegible] of the said District.

Each bid must be ac[illegible]panied by a certified check or cash [illegible] amount of two thousand ($2,000.00) [illegible] dollars. All certified checks must be [illegible]wn on some responsible bank doing [illegible]ness in the City of Chicago, and shall [illegible] made payable to the Clerk of the S[illegible]itary District of Chicago. Said amount [illegible] two thousand ($2,000.00) dollars, [illegible]posited with bids, shall be held by the Sanitary District until all of the resp[illegible]ve bids for said structure have been [illegible]assed and the contract awarded and si[illegible]d. The return of said check or cash [illegible] the bidder to whom said work shall have been awarded will be conditioned upon his appearing within ten (10) days after receiving notice of such award, with bondsmen, and executing a contract with the Sanitary District for the work so awarded, and giving a bond, satisfactory to the Board of Trustees, for the fulfillment of said contract in the amount of twenty thousand ($20,000.00) dollars.

A deposit of ten ($10.00) dollars in cash or a certified check for that amount will be required for each set of plans and specifications taken out, the said sum of ten ($10.00) dollars to be refunded by the said Sanitary District upon the return of the said plans and specifications to said District, provided they are returned on or before December 21, 1908.

All bids must be upon blank forms furnished by the Sanitary District.

Bidders are required to state in their bids their individual names and places of residence in full.

The said Board of Trustees reserves the right to reject any and all bids.

THE SANITARY DISTRICT OF CHICAGO.

By ROBERT R. McCORMICK,
President of Its Board of Trustees.

Attest:
I. J. BRYAN, Clerk.
Chicago, November 18, 1908.

COUNTY ROAD.

3½ MILES.

Salem, N. S., Nov. 17, 1908.

Sealed proposals will be received by the Road Committee of the Board of Chosen Freeholders, of the County of Salem, on Wednesday, December 9, 1908, at 10.30 o'clock, a. m., at the Court House, Salem, N. J., for grading and placing gravel surface on the Barnsboro Turnpike (3.31 miles), in the Township of Upper Pittsgrove, and Borough of Elmer, Salem County, N. J.

Specifications may be obtained and plans and profiles examined at the office of Howard B. Keasbey, Mecum Building, Salem, N. J., and also at the office of the State Commissioner of Public Roads, State House, Trenton, N. J. A certified check in the sum of $1,000, made payable to the order of the Directors of the Board of Chosen Freeholders of Salem County, N. J., must accompany each bid, as a guarantee that the bidder will enter into a contract should the work be awarded to him. The right to reject any or all bids is reserved.

JOHN F. AYARS,
Director.

TREASURY DEPARTMENT, Office of the Supervising Architect, Washington, D. C., November 17, 1908.—Sealed proposals will be received at this office until 3 o'clock p. m., on the 29th day of December, 1908, and then opened, for the construction (including plumbing, gas piping, heating apparatus, electric conduits and wiring), of the U. S. Post-Office at Alton, Ill., in accordance with drawings and specifications, copies of which may be obtained from the Custodian of Site at Alton, Ill., or at this office at the discretion of the Supervising Architect. JAMES KNOX TAYLOR, Supervising Architect.

NOTICE TO CONTRACTORS

We are advised by the Sanitary District, of Chicago, that the advertisement for Bridge Superstructure on page 44 of this issue is superseded by a similar advertisement, with later date, on this page.

ENGINEERING NEWS

A JOURNAL OF CIVIL, MECHANICAL, MINING AND ELECTRICAL ENGINEERING

Vol. 60. No. 22. 220 Broadway, New York, November 26, 1908.

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TEST OF FOUR 35,000,000-GAL. CENTRIFUGAL PUMPING UNITS AT PITTSBURG.

The following extracts from a report submitted by A. B. Bellows, of the Pittsburg Testing Laboratories, and C. C. Pascheday, District Engineer of the Allis-Chalmers Co., to Mr. Morris Knowles, M. Am. Soc. C. E., Chief Engineer of the Bureau of Filtration, Pittsburg, show the results of duty tests on the new pumping units

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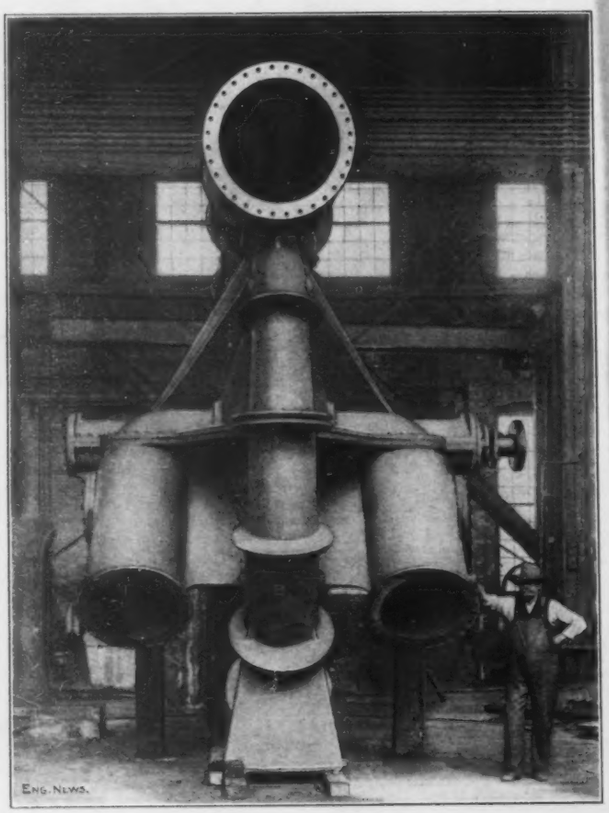

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TWO VIEWS OF 35,000,000-GAL. CENTRIFUGAL PUMP BUILT FOR ROSS PUMPING STATION, PITTSBURG, PA., BY THE ALLIS-CHALMERS CO., MILWAUKEE, WIS.

of the Ross Pumping Station furnished by the Allis-Chalmers Co., of Milwaukee:

REQUIREMENTS OF THE CONTRACT.—The contract requires that the pumping units shall each consist of a horizontal shaft, single stage, double suction, centrifugal pump, direct connected to a vertical compound condensing engine with condenser, air pump and all accessories and appurtenances.

Each unit shall have a capacity of at least 35,000,000 gals. in 24 hrs. against a total head of 60 ft. and a proportional amount at intermediate heads.

The requirements of the trial shall be that each unit shall pump at the rate of 35,000,000 gals. of water in

tion head indicated by a mercury gage on the suction, and adding the difference between the zero planes of the two gages. No allowance shall be made for the loss of head due to friction in the pump.

In computing the duty, the total steam used by the engine in any way, shall be weighed and charged to the engine, and steam containing 1½% or less of moisture as determined by an approved form of throttling calorimeter, shall be considered as commercially dry steam.

DESCRIPTION OF THE CENTRIFUGAL PUMPING UNITS.—The centrifugal pumping engines are four in number, exactly alike, and are designated as No. 1, No. 2, No. 3 and No. 4, and are of the horizontal-shaft, single-stage, double-action, centrifugal type, each direct-con-

the cut-off in the high-pressure cylinder, while the cut-off in the low-pressure cylinder is adjustable by hand.

The water is taken from the Allegheny River.

The principal dimensions are given in Table I.

The first trial was made on Engine No. 1 from 8 a. m. to 6 p. m., Aug. 12, 1908; the second trial was made on Engine No. 2 from 8 a. m. to 6 p. m., Aug. 17, 1908; the third trial was made on Engine No. 4 from 8 a. m. to 6 p. m., Aug. 24, 1908; the fourth trial was made on Engine No. 3 from 8 a. m. to 6 p. m., Aug. 26, 1908. The durations of test in each case was ten hours.

FEED WATER.—On account of the general arrangement of the steam piping and the boilers, it was not feasible to weigh the water before it was pumped into the boilers.

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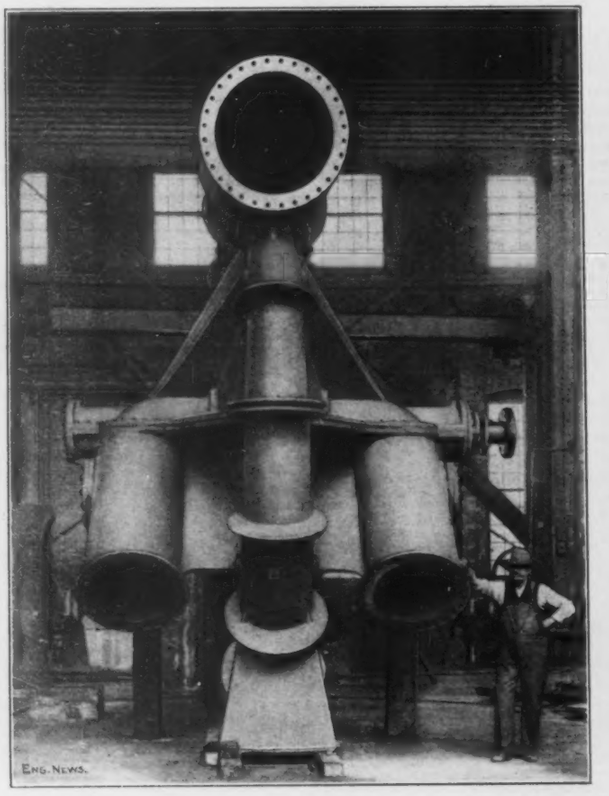

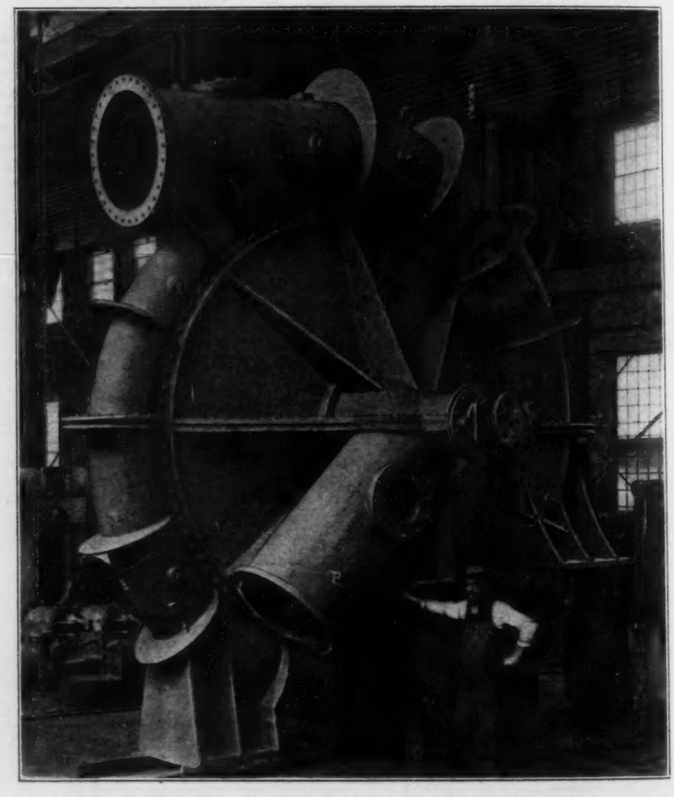

TWO VIEWS OF 35,000,000-GAL. CENTRIFUGAL PUMP BUILT FOR ROSS PUMPING STATION, PITTSBURG, PA., BY THE ALLIS-CHALMERS CO., MILWAUKEE, WIS.

REQUIREMENTS OF THE CONTRACT.—The contract requires that the pumping units shall each consist of a horizontal shaft, single stage, double suction, centrifugal pump, direct connected to a vertical compound condensing engine with condenser, air pump and all accessories and appurtenances.

Each unit shall have a capacity of at least 35,000,000 gals. in 24 hrs. against a total head of 60 ft. and a proportional amount at intermediate heads.

The requirements of the trial shall be that each unit shall pump at the rate of 35,000,000 gals. of water in 24 hrs., with a total head of 46 ft., and shall develop 70,000,000 foot-pounds of work done for each thousand pounds of commercially dry steam used by the pumping engine and accessories for all purposes. The average speed of steam pistons shall not be more than 800 ft. per min. while each engine is pumping 35,000,000 gals. per day of 24 hrs., when running at maximum speed.

The determination of the quantity of water pumped during the trial shall be by a Venturi meter. The lift shall be computed by adding the head indicated by a mercury gage attached to the discharge main to the suction head indicated by a mercury gage on the suction, and adding the difference between the zero planes of the two gages. No allowance shall be made for the loss of head due to friction in the pump.

In computing the duty, the total steam used by the engine in any way, shall be weighed and charged to the engine, and steam containing 1½% or less of moisture as determined by an approved form of throttling calorimeter, shall be considered as commercially dry steam.

DESCRIPTION OF THE CENTRIFUGAL PUMPING UNITS.—The centrifugal pumping engines are four in number, exactly alike, and are designated as No. 1, No. 2, No. 3 and No. 4, and are of the horizontal-shaft, single-stage, double-action, centrifugal type, each direct-connected to a vertical compound condensing engine of the crank and fly-wheel type, with a receiver between the high and low pressure cylinders.

There is one fly-wheel located on the main shaft between the high and low pressure cylinders. The cranks are set at an angle of 90° apart. The condenser is of the surface type. The air pump is of the Edwards type (chain connected to shaft of main pumps.—Ed.). The steam valves are of the Corliss type, and are placed in the cylinder heads. A ball-governor is provided to regulate the speed of the engine by varying the point of the cut-off in the high-pressure cylinder, while the cut-off in the low-pressure cylinder is adjustable by hand.

The water is taken from the Allegheny River.

The principal dimensions are given in Table I.

The first trial was made on Engine No. 1 from 8 a. m. to 6 p. m., Aug. 12, 1908; the second trial was made on Engine No. 2 from 8 a. m. to 6 p. m., Aug. 17, 1908; the third trial was made on Engine No. 4 from 8 a. m. to 6 p. m., Aug. 24, 1908; the fourth trial was made on Engine No. 3 from 8 a. m. to 6 p. m., Aug. 26, 1908. The durations of test in each case was ten hours.

FEED WATER.—On account of the general arrangement of the steam piping and the boilers, it was not feasible to weigh the water before it was pumped into the boilers.

SUCTION AND DISCHARGE HEADS.—The contract calls for a maximum of 14 ft. suction. On account of the river being very low, it was not possible to have this condition. The pumps, therefore, were tested under a suction of from 15.06 to 16.47 ft. and in each of the four tests exceeded the maximum suction. This, of course, was unfavorable to the performance of the pumps. The discharge head, also, varied several feet during the test, because the water was drawn from the basins at a faster rate than delivered by the one pump under test. The conditions, therefore, under which each of these tests was made, were an excessive suction with a variable discharge, which made it necessary to run engines at a higher rate of speed than would have been required had the suction been normal, and the discharge constant.

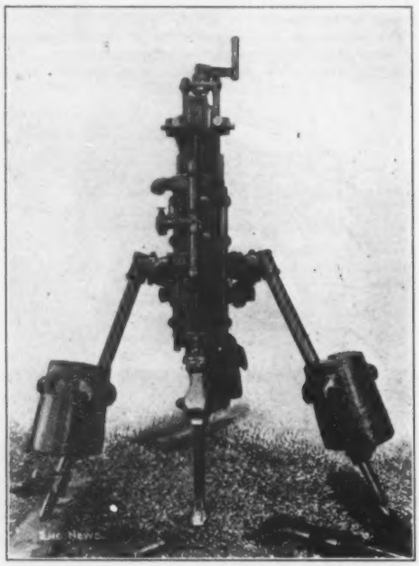

Fig. 1. L. L. Scott's Gasoline Rock Drill, Air-Cooled Style, Mounted on Tripod.

The speed, also, had to be slowly reduced as the head in the basins decreased.

OBSERVERS.—During each test there were present two sets of observers, one representing the contractor, and one representing the Bureau of Filtration. The latter were professors and students of the Carnegie Technical Schools, and several students from Cornell University.

Observations were taken every 20 minutes throughout the test, each observation being checked by the two observers.

MUNICIPAL OWNERSHIP IN VIENNA, AUSTRIA.—First among the enterprises carried on by the municipality is the city grain elevator and storage warehouse, built in 1876. Then come the central cattle market (1885); cemeteries (1889); Rathauskeller, a very fine restaurant in the basement of the Town Hall (1898); gasworks (1899); electric lighting works (1902); tramways (1902); brewery of the City of Vienna (1905); and municipal funeral undertaking (1907). Besides these, the City Council control and operate a life insurance society and five savings banks. Altogether the city employs 8,950 officials, whose salaries aggregate £640,000, an average of £71 a head. Since the beginning of the year, for instance, a municipal funeral insurance association has been organized, with a branch department for insuring the cost of tombstones! And now the Council are seriously considering the purchasing of coal mines, chiefly for supplying their gas and electrical works.—"The Engineer" (London).

A DIRECT-ACTING GASOLINE ROCK-DRILL.

A novel rock-drill—one operated by gasoline and at the same time a direct-striking machine, the drill rod being a prolongation of the piston—has been built by Mr. L. L. Scott, of Joplin, Mo., and is to be put on the market in a short time. It has been designed in an air-cooled and in a water-cooled style. The two half-tone views herewith show the air-cooled machine on its tripod in partially dismantled condition (Fig. 1), and the piston-drillrod element removed from the cylinder (Fig. 2). The driving part of the machine is a pair of two-stroke gasoline engines. A gasoline-operated rock-drill has already been described in these pages (Eng. News, April 13, 1905, p. 385, the "Bull-Dog" rock-drill); in this, however, the engine was not a part of the drill, the latter being a crank-and-hammer mechanism driven from a separate engine by a flexible shaft.

The arrangement of mechanism in the Scott drill is shown by the longitudinal section Fig. 3. The two cylinders are set end to end, one above the other, the lower one opening downward and the upper one upward. Their pistons are mounted on a common rod, which, where it passes through the septum between the working chambers of the two cylinders, is packed to prevent gases passing from one chamber to the other. The upper piston contains a spring-mounted wrist-pin engaged by a connecting-rod which drives a short crank-shaft at the extreme upper end of the machine. The lower end of the piston-rod has a swivel joint so that the pistons are not rotated when the drill-rod rotates. The rotation-device is fixed in the bottom cylinder-head, and the swivel in the rod is therefore inside the cylinder.

The cylinder body of the drill is arranged to slide axially along the supporting frame, under control of a feed screw. The crank-shaft being seated in this frame, while the lower limit of travel of the pistons is fixed by the drill striking the rock, there can be no rigid connection between piston-rod and crank. A yielding connection is therefore provided in the crank-pin end of the connecting-rod.

The gas-engine element of the machine is arranged as usual for compressing the charge in the crank-case on the working stroke, and forcing it into the cylinder at the end of this stroke, just after the exhaust port is uncovered by the piston. Valves and operating rods are not required. Ignition is by jump-spark, controlled by a variable timer fixed on one end of the crankshaft.

As the engine makes one explosion per stroke, twice as much heat must be radiated from the cylinder casting as in the ordinary two-stroke cycle engine, and it would seem that unusually ample cooling would be needed. In the air-cooled style, however, the builder has provided nothing more than a series of radiating ribs at the middle of the cylinder casting, covering the combustion-chambers and a small part of the stroke. For additional cooling, Mr. Scott states, he uses a small fan, driven by a flexible shaft from the crankshaft, to direct a blast of air against the cylinders. While the cooling arrangements seem so extremely inadequate that the engine would be expected to give trouble from overheating if a run of any length were attempted, the builder says he has no trouble from this source. As an actual instance:

In one specific test the length of runs was 15 mins. before it was necessary to change steel, in another about 8 mins.; the holes drilled were 12 ft. deep; the time of actual drilling was 48 mins. I can run all day without trouble.

The construction of the cylinder of the air-cooled machine seems ill adapted for high temperatures, as it is split longitudinally to admit the assembled pistons and rod. In the water-cooled machine, the middle head only is split.

The drill shown in our view is stated to weigh 174 lbs., and to be able to drill 3 ins. per min. in hard rock. Its fuel consumption is given as ⅛ gal. gasoline in 15 mins. when doing hard drilling.

A very great economy of fuel is claimed over air drills. Besides, of course, there is the great advantage that boiler, engine, compressor and pipe-line are eliminated.

Mr. Scott is also building a double-acting drill of the hammer type, which differs from the above-described machine in the chucking and rotating arrangements. This is a lighter machine, and somewhat easier and cheaper to handle. He also has a small single-acting drill of hammer type, weighing but 90 lbs., which he expects to enter in the stope drill contest to be held next year by the Transvaal government.

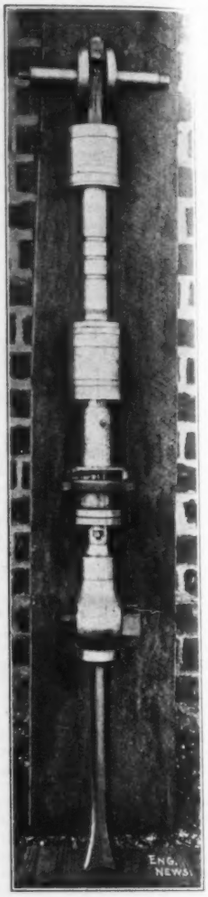

Fig. 2. Drill Rod and Piston of Scott's Gasoline Rock Drill.

A VIADUCT CONNECTION, in Cincinnati, Ohio, from the approach of the Louisville & Nashville Ry. bridge eastward to connect with new bulk freight yards, was commenced by the above railway some years ago. The yards are east of Vine St. and south of Water St. The connection with the railway company's bridge involved an inclined viaduct, but the completion of this structure across the top of the public steamboat landing was fought by the river interests. The courts sustained their view that the city council had no power to grant the railway company the right across the public property. It is stated that at the next meeting of the Ohio legislature steps will be taken to secure the passage of legislation which will permit the completion of the viaduct, which now ends at the boundary of the public property.

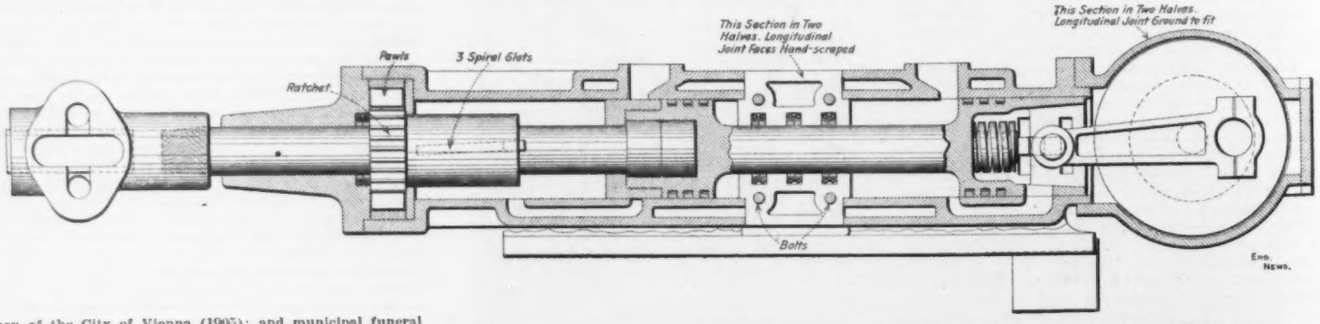

FIG. 3. LONGITUDINAL SECTION OF WATER-COOLED FORM OF GASOLINE ROCK DRILL.

TABLE I.—PRINCIPAL DIMENSIONS OF CENTRIFUGAL PUMPING UNITS, ROSS PUMPING STATION, PITTSBURG, PA.

Number of steam cylinders	2
Diameter of high pressure cylinder, ins.	16
Diameter of low pressure cylinder, ins.	34
Diameter of piston rod H. P. cylinder, ins.	2 15/16
Diameter of piston rod L. P. cylinder, ins.	3⅞
Length of stroke, ins.	36
Diameter of crank pin H. P., ins.	8.5
Diameter of crank pin L. P., ins.	8.5
Length of crank pin H. P., ins.	4
Length of crank pin L. P., ins.	4
Main shaft, length at bearings, ins.	15
Main shaft, diameter at bearings, ins.	9
Main shaft, diameter at fly-wheel, ins.	13
Fly-wheel, diameter, ft.	8
Fly-wheel, weight, lbs.	8,000
CONDENSER AND AIR PUMP.	
Condenser, style, surface.	
Condenser surface, sq. ft.	1,000
Air pump, style, Edwards, single acting.	
Air pump, number plungers	3
Air pump, diameter plungers, ins.	6
Air pump, stroke, ins.	6
Diameter of suction nozzles, ins.	28
Diameter of discharge, ins.	30
Diameter of impeller, ft.	11
Diameter of shaft at impeller, ins.	13

TABLE II.—RESULTS OF TRIALS, CENTRIFUGAL PUMPING UNITS, ROSS PUMPING STATION, PITTSBURG, PA.

Date of trial	Aug. 12, 1908.	Aug. 17, 1908.	Aug. 26, 1908.	Aug. 24, 1908.
Station number of centrifugal pumping unit	No. 1.	No. 2.	No. 3.	No. 4.
Duration of trials, hours	10	10	10	10
Average temperatures, F.:				
Water pumped	78.5	80.1	73.5	75.0
Condensed steam	88.9	90.7	82.4	82.7
Exhaust steam	110.5	116.5	131.3	127.1
Cooling water to condenser	77.9	79.3	73.2	75.5
Cooling water from condenser	84.9	86.1	84.0	83.9
Engine room	93.6	93.3	85.5	85.5
Outside air	86.0	85.1	69.8	72.3
Average pressures:				
Barometer, ins.	29.07	29.05	29.21	29.17
Barometer (corrected for sea level), ins.	29.92	29.90	30.06	30.02
Barometer (corrected for sea level), lbs.	14.69	14.67	14.76	14.74
Steam at throttle (corrected reading), lbs.	148.1	151.4	150.0	151.2
Absolute steam at throttle, lbs.	162.79	166.07	164.76	165.94
Vacuum, ins.	26.94	26.4	25.25	26.44
Vacuum (corrected for sea level), ins.	27.79	27.25	26.10	27.29
Vacuum (corrected for sea level), lbs.	13.64	13.38	12.82	13.40
Receiver, lbs.	25.0	11.2	10.0	10.8
Discharge head, mercury column, ins.	33.13	32.84	33.39	32.11
Discharge head, ft.	37.50	37.18	37.70	36.35
Suction head, mercury column, ins.	12.05	12.53	12.63	12.22
Suction head, plus distance between gage (22 ins.), ft.	16.47	16.01	16.13	15.06
Total head, ft.	52.97	53.19	53.83	52.01
Total head, lbs.	22.93	23.03	23.30	22.52
Revolutions:				
Total number of revolutions	65,946	66,941	66,707	66,524
Number of revolutions per minute	109.91	111.57	111.28	110.87
Piston speed, ft. per min.	659.5	669.4	667.7	665.2
Steam:				
Quality of steam, moisture, per cent.	1.32	1.24	not over 1.50	not over 1.50
Steam used by engine, condenser, lbs.	79,920	90,043	79,704	84,415
Steam per hour, uncorrected for moisture, lbs.	7,992	9,004	7,970	8,442
Horse-power:				
Average I. HP. high pressure cylinder	278.89	290.73	311.67	323.75
Average I. HP. low pressure cylinder	318.51	250.86	244.01	290.02
Total I. HP.	597.40	541.59	555.68	583.77
Pump horse-power	357.34	398.91	362.22	368.95
Friction horse-power and slip	240.06	142.68	193.46	214.82
Friction horse-power and slip, per cent. of I. HP.	40.19	26.34	34.82	36.80
Steam per I. HP. per hour, lbs.	13.38	16.62	14.34	14.46
Steam per P. HP. per hour, lbs.	22.37	22.57	22.00	22.88
Capacity:				
U. S. gallons, pumped, 10 hrs., by Venturi meter	16,050,000	17,850,000	16,000,000	16,870,000
U. S. gallons, proportional rate 24 hrs.	38,520,000	42,840,000	38,400,000	40,488,000
U. S. gallons per hour	1,605,000	1,785,000	1,600,000	1,687,000
U. S. gallons per revolution	243.4	266.7	239.7	253.6
Capacity requirement of contract, gals.	35,000,000	35,000,000	35,000,000	35,000,000
Duty:				
Total foot-pounds of work during test	7,075,252,257	7,898,353,280	7,171,878,540	7,305,304,836
Duty—ft.-lbs. per 100 lbs. of steam	88,529,200	87,717,000	80,981,420	86,540,370
Duty requirement of contract	70,000,000	70,000,000	70,000,000	70,000,000

Therefore, the condensed steam was carefully weighed, care being taken that all connections of the condenser were broken and blank flanges applied, except the one connection delivering to the condensed steam.

CALORIMETER TEST.—A Carpenter throttling calorimeter was attached close to the throttle in each test, and calorimeter tests made each hour. The average of these tests on Engine No. 1 and Engine No. 2 showed that the steam contained less than 1½% of moisture. In tests on Engines 3 and 4 the connections were not properly made to the steam pipe, and there were leaks around these connections which could not be remedied, which reduced the pressure on the calorimeter to such an extent as to make the results of the calorimeter erroneous. However, it was agreed to accept the results shown by the first two tests, where the steam contained less than 1½% moisture and therefore no allowance for the moisture of the steam was made to the engines, and the steam in each of the four tests was taken as being commercially dry.

INDICATOR CARDS.—On account of the contract of these engines not calling for any definite requirements for indicated horse-power and friction horse-power, indicator cards were not taken at as close intervals throughout the test as would have been the case had it been necessary to determine accurately the indicated working of the engines. Sufficient indicator cards, however were taken during the forenoon and afternoon to give a close approximation of the indicated working of the engines. Sample indicator cards are attached to this report. These indicator cards do not show in all cases, an equal division of the work between the top and bottom of each cylinder, or between the low pressure and high pressure cylinders. The contractor did not see fit to nicely adjust the valves prior to the test, so as to give more equal distribution of the work. However, the difference does not effect the results, as the pumps were run well within their maximum power and it was not possible to make the adjustments without shutting down the engine. It is possible to easily make the necessary adjustments so that the division of the work is fairly equal between the top and bottom of each cylinder, and between the high and low pressure cylinders.

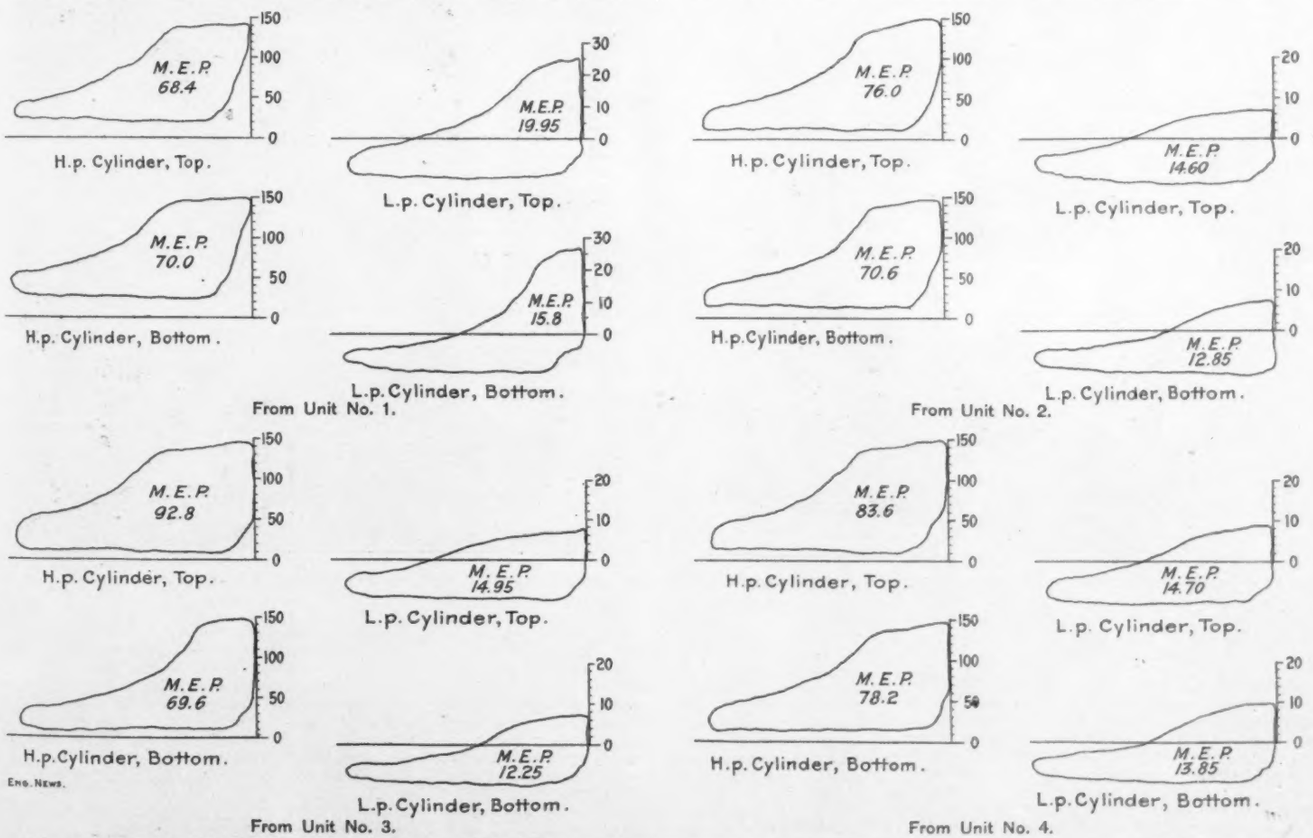

FIG. 1. REPRESENTATIVE INDICATOR CARDS OF COMPOUND ENGINES DIRECT CONNECTED TO 35,000,000-GAL. CENTRIFUGAL PUMPS. (Obtained During Acceptance Trials.)

be produced at will by increasing or decreasing the electromotive force at the terminals of the cell.

Iron highly charged with hydrogen is very inert, and not readily attacked by acids. The softer quality is also comparatively inert. Equal surfaces of wrought iron and electrolytic iron were immersed in pure hydrochloric acid (2° Twaddell) for 18 hours. The electrolytic iron lost 2.48% of its weight and the wrought iron 13.13%.

The temperature required for annealing electrolytic iron is slightly in excess of that required for ordinary rolled sheets. Electrolytic iron, when heated in a closed annealing box, gives off large quantities of hydrogen; and if a pipe is fitted to the annealing box the hydrogen flame can be kept burning during the whole process of annealing, and for a considerable time after the heat has been removed from the annealing box. This phenomenon has been turned to account for removing scale from ordinary rolled sheets by placing some sheets of electrolytic iron in an ordinary annealing box with plates to be scaled. Electrolytic iron gives up considerable quantities of its hydrogen under 100° C. without losing its brittleness, and also when boiled in water or oil.

When iron is deposited under magnetic conditions—that is, if a powerful magnet is placed behind the cathode—lines of magnetic force are obtained similar to those rendered visible with iron filings.

CONCLUSION.—The electrolytic production of iron and steel has now emerged from the laboratory or academic stage to a practical conception, enabling iron and steel to be produced in a highly finished form from iron ore or scrap iron, in a condition which realizes the highest market value, by a process which reduces labor to a minimum, and under conditions which can be compared to the working of a central electric light station for cleanliness and health.

In conclusion, the advantages may be summarized as follows:

(1) Finished products, such as tubes, sheets and wire can be produced at less cost than by the process of smelting, refining and rolling. (2) A product is obtained which does not corrode as readily as steel, at less cost. (3) The process can be worked economically when no coal is available. (4) Iron ore that is useless for ordinary smelting operations can be advantageously utilized by the electrical process. (5) The process is a power process, and utilizes but little labor. Small units can be worked economically. (6) The process is more cleanly and healthy than the operations of smelting. (7) Little or no scrap is formed.

[The author in an appendix gives the total cost of a 5,000-ton plant as about $528,500 and the cost of operation with current at 0.5 cts. per KW.-hr. is $26.30 per ton of sheet, tube or wire. With current at 0.2 ct. per KW.-hr., as in Sweden, the cost of the product was given as $18.80 per ton. The cost per ton for wages, management, interest, depreciation, etc., is given as $12.50. The author also gave a table and curve showing the deposition of iron per hour for different current densities. The curve is reproduced in Fig. 3.—Ed.]

REINFORCED-CONCRETE BINS FOR THE STORAGE OF CRUSHED STONE.

In the accompanying half-tone and cut is shown a novel combination bin and trestle construction recently completed by the city of Springfield, Mass., for the storage of crushed stone used in the municipal paving work. The trestle is connected with the Boston & Albany R. R., so that stone cars can be directly run thereon and the material dumped into the bins, from under which carts can draw the stone whenever needed. The structure is 182 ft. long and 15 ft. 6 ins. wide, consisting of a series of 16 columns, in two rows, carrying beams in both directions, upon which rest the bin floors and sides. In the bottom of each panel is a hopper through which the stone is drawn. The wooden trestle, carrying the railroad tracks, consists of bents resting over each transverse row of columns. The details of the reinforced-concrete construction are evident from the drawing in Fig. 1.

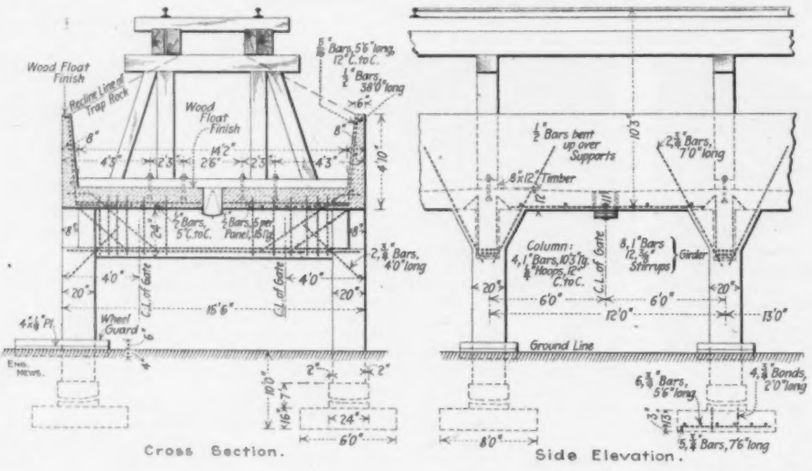

FIG. 1. REINFORCED-CONCRETE STORAGE BINS FOR THE STORAGE OF PAVING CRUSHED STONE, SPRINGFIELD, MASS. (Built by the Turner Construction Co., New York.)

The footings are generally 8 × 6 ft. by 16 ins. thick, reinforced with a cross grillage of ¾-in. bars. Soft muck was encountered in the foundations, so that the footing work presented some difficulty, but in the six months which have elapsed since the completion of the structure no settlement has been observed. At one end, the columns had to be carried over an existing sewer on cross-girders resting on footings on either side.

A 1:2½:4 concrete, with cold-twisted bars for reinforcement, was used, placed according to the loose rod system of the Turner Construction Co., New York, who were the contractors on the work. The bins were built under the direction of Mr. A. A. Adams, Superintendent of the Street Department. The total cost was about $8,000.

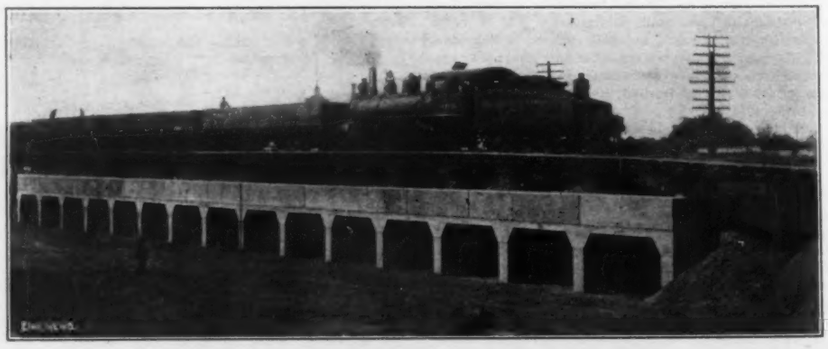

FIG. 2. VIEW OF THE SPRINGFIELD STONE STORAGE BINS.

SOME POSSIBILITIES OF THE GASOLENE TURBINE.*

By FRANK C. WAGNER,† M. Am. Soc. M. E.

In considering the possibilities of a gas turbine it has commonly been assumed that the gas should be burned with something near the theoretical quantity of air required for complete combustion, as is done in the explosion gas engine of the ordinary type. Under this condition the temperature of the gases when they strike the turbine wheel is so high that the metal of the wheel reaches a temperature at which its strength is seriously diminished.

It may be possible to pass water through the turbine wheel and keep down the temperature of the body of the wheel. But the blades, being long and thin, would become much hotter than the body of the wheel, and to pass water through the blades themselves would complicate the construction of the wheel enormously.

Two methods of reducing the temperature of the gases themselves are possible. One method is to use an excess of air in burning the gas or gasolene, sufficient to keep the temperature of the gases after expansion in the nozzles within safe limits. The other method is to inject a liquid, preferably water, into the gases. The liquid absorbs heat, becoming superheated vapor, and the vapor furnishes work during expansion. It is the purpose of this paper to compare the above methods of reducing the temperature of the gases, and especially to consider how such comparison is affected by variations in the efficiencies of the turbine and the air compressor.

The cycle of the type of gasolene turbine here considered is similar to that of the Diesel engine. The air is first compressed up to the maximum pressure. Fuel, either gas or oil, separately compressed, is then introduced and burned under pressure. The volume of the air is thereby expanded at constant pressure. After the burning is completed the hot gases expand adiabatically and the pressure drops. In the Diesel engine the expansion is incomplete, while in the gas turbine the expansion may be complete down to atmospheric pressure.

The efficiency of the above cycle may be readily found if both compression and expansion be assumed to be adiabatic. Let T_4 be the absolute temperature of the air just before compression; T_1 the temperature at the end of the compression; T_2 the temperature when the combustion is just completed; and T_3 the temperature at the end of the expansion. Assume the expansion to be complete. Then the ratio of the pressures at the extremities of an adiabatic change, sometimes called the compression pressure ratio, is the same for the expansion line as for the compression line. Denote this ratio by ρ. Let C_p denote the specific heat of air at constant pressure, and γ the ratio of the specific heats.

Since the net mechanical work done equals the difference between the heat absorbed and the heat rejected during a complete cycle, it follows that the efficiency can be expressed as shown in the formulas on the next page.

The interesting feature of this expression for efficiency is that the theoretical efficiency depends only upon the ratio of compression. It does not depend on the maximum temperature reached. Consequently, from a theoretical standpoint it makes no difference whether the fuel is burned with the theoretical amount of air or

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†Professor of Steam Engineering, Rose Polytechnic Institute, Terre Haute, Ind.

THE PRODUCTION OF IRON SHEETS AND TUBES FROM ORE IN ONE OPERATION.*

By SHERARD COWPER-COWLES.†

Hitherto it has been the universal custom to produce iron or steel sheets, tubes, and wire by a process of smelting the iron, refining, cementation, annealing, rolling, or drawing. The object of the present paper is to describe an electrolytic process for making tubes, cylindrical vessels, sheets, and wire in one or two operations from crude or scrap iron, or direct from the ore, without the processes of smelting, rolling, or drawing, at a cost that has hitherto been thought impossible. It is generally believed that iron and other metals refined by electrolysis are quite free from those impurities which are invariably associated with metals produced by a

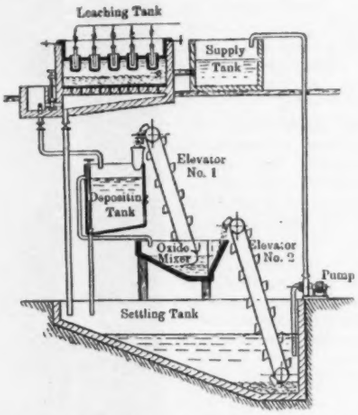

Fig. 1. Diagrammatic Arrangement of Cowper-Cowles' Plant for the Direct Production of Iron Sheets and Tubes.

smelting process. Electrolytic iron can be obtained almost chemically pure when special precautions are taken, but even then, when the product is made to form the poles of an electric arc lamp and the spectrum is carefully examined, there is evidence of the presence of minute quantities of impurities.

One of the first, if not the first, to mention iron produced electrolytically, was Bockbushmann in 1846. He deposited on a copper matrix a plate of iron 150 mm. square (5.9 ins.) and 2mm. thick (0.079 in.) In 1857 Feuquieres exhibited specimens of electrolyte iron at the Paris Exposition. Up to the present time the process of electrodeposition of iron has been confined to the facing of engraved copper plates for fine printing, such as bank notes, as iron has the advantage of being easily removed with acid when worn through, thus enabling the iron facing to be renewed without damage to the copper plate. Klein introduced a process in Russia for the production of iron electrotypes for bank-note printing—that is, the plates were made of solid electrolytic iron instead of being copper faced with iron. The electrolyte used was composed of ferrous and magnesium sulphates, a current density as low as 0.3 amp. per square decimeter being necessary, 1½ months being required to give a thickness of 2 mm. (0.079 in.)

The author in the year 1898 made a number of experiments on the production of electrolytic iron plates, and produced plates of considerable thickness, but in such a rough condition that they required smelting and rolling; the rate of deposition, moreover, was so slow as to render the process impracticable, and it was not until the year 1900 that he succeeded in obtaining some small tubes. The results obtained were a great advance on what had hitherto been effected, but were not far enough advanced to be turned to practical account; it was not until the present year that sheets and tubes were obtained of a quality equal to steel, and with a surface that required no after-treatment, such as rolling or drawing.

An electrolytic iron production process, to be of commercial value, must fulfil the following conditions: The voltage between the terminals of the depositing cell must be low, the current density per sq. ft. of cathode surface must be high, and the iron or steel deposited must be in such a form that it can be used for industrial purposes without smelting. An electrolytic process that fulfils these conditions must revolutionize many branches of the iron trade, as it will enable thin iron tubes and sheets in particular to be produced at a very low cost, and without the necessity of burning coal.

The process briefly consists in placing crude iron (which may contain those elements which are at present so detrimental to the production of high-class iron or steel), or finely divided iron ore, in suitable containing vessels in which an acid solution is circulated using an insoluble anode material; or, further, the process may combine the use of soluble and insoluble anodes. The crude iron or iron ore being in each case connected to the positive pole of a dynamo, the iron goes into solution, and is deposited on cylinders or plates which may be either rotated or stationary, depending upon the class of finished product required.

Fig. 1 represents the general arrangement of the apparatus employed when depositing iron from crude iron or the ore. In the former case the iron is arranged around the cathode, and in the latter insoluble anodes, of graphite, for example, a small electric current being employed to assist the leaching process. It is conceivable that in some cases iron might be recovered without mining, acid liquor being circulated over the ore deposits. The process lends itself to the recovery of iron more especially from carbonated ores, "blue billy," Lake, and Bog ores. An electric process will no doubt prove to be a valuable adjunct where pig iron is used for precipitating copper, enabling the iron to be recovered instead of letting it run to waste.

Good results have been obtained from an ore containing:

Ferric oxide	50.7 %
Lime	3.8 %
Phosphoric acid	1.51%
Alumina	10.0 %
Silica	10.0 %

When it is desired to produce a highly finished sheet, a metal sheet of the desired surface is wrapped round the cathode, and held in position by means of grooves and wedges. In this way, sheets of large dimensions can be made; by employing a mandrel, say 8 ft. in diameter, a sheet 24 × 7 ft. can be produced.

When it is desired to produce tubes, iron mandrels somewhat smaller than the internal diameter of the finished tube are coated with lead by electro-deposition, or by having lead drawn over them. Thus prepared, the mandrels are rotated in such an apparatus as is shown in Fig. 2. When the desired thickness of iron has been deposited, the mandrel is heated to a temperature sufficient to melt out the lead, and thus admit of its easy withdrawal.

The electrolyte employed consists of a 20% solution of sulpho-cresylic acid saturated with iron. (Sulpho-cresylic acid is a cresol-sulphonic acid containing approximately 108 parts of cresol and 98 parts of sulphuric acid. The cresol contains ortho, 25%; meta, 40%, and para 25%. This cresol is heated with sulphuric acid, yielding isomeric cresol-sulphonic acids.)

In some cases it is advantageous to add small quantities of carbon-disulphide, the temperature of the solution being about 70° C., and the current density about 100 amps. per sq. ft. The solution is kept charged with iron oxide, which is kept in suspension in the electrolyte by means of stirrers, by moving one or both of the electrodes, or by circulating by means of a bucket pump, as shown in Fig. 1. The specific gravity of the electrolyte having the iron oxide in suspension is about 1.32.

Excellent results have also been obtained by depositing the iron in a closed cell with a vacuum of a few inches and also with a chloride solution and porous cells, bleaching

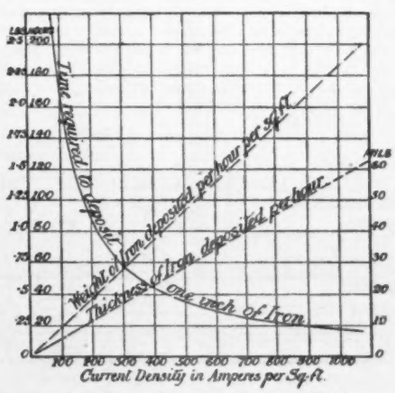
Time required to deposit one inch of Iron.
Weight of Iron deposited per hour per sq. ft.
Thickness of Iron deposited per hour.
Current Density in Amperes per Sq. Ft.

Fig. 3. Curves Showing Weight and Thickness of Iron Deposited for Different Current Densities (Cowper-Cowles).

powder being produced as a by-product; or the chlorine utilized to form fresh iron chloride.

The following are two typical analyses of electrolytic iron produced under the conditions described in this paper:

SAMPLE I.

Carbon (by combustion)	0.060%
Silicon	0.011%
Sulphur	0.016%
Phosphorus	0.041%
Manganese	traces
Arsenic	0.004%

SAMPLE II.

Combined carbon	under 0.05%
Silicon	0.048%
Sulphur	0.045%
Phosphorus	0.04%
Arsenic	0.01%
Manganese	traces

A peculiar feature of electro-deposited iron is that it creeps to an extraordinary degree with a rounded, smooth edge over any material; in fact it is difficult to stop its spreading. Under certain conditions, when employing a rotating cathode, long tentacles form, 6 ins. or more in length, in the directions of rotation with approximately the same curvature as the mandrel.

Among other applications the process can be applied to the production of bimetallic tubing and plates; that is to say, to tubes or sheets coated on the one side with copper or other metals or alloys.

The process can also be applied to the direct production of large sheets or strips representing the cutting surface of a file, and cut up into portions of the desired shapes,

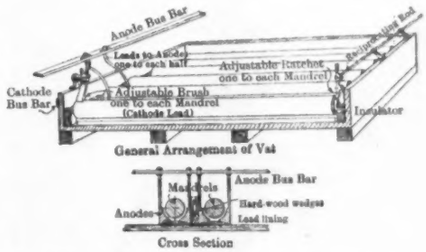

Fig. 2. Arrangement of Vats and Mandrels for the Production of Iron Tubes; Cowper-Cowles' Process.

and secured to suitable backing, to form separate files. The prints are produced by making a continuous impression or a number of impressions from a suitable die, revolving roller, or reciprocating tool in a lead alloy. The matrix thus prepared is mounted on a revolving drum, and steel deposited by the process which has already been described.

Electrolytic steel, with considerable variation in the percentage of carbon, can also be produced. Houllevigue observed that when iron is deposited from iron containing uncombined carbon, the product at the cathode was free from carbon; but when deposited from iron containing combined carbon, the cathode product also contained carbon. The author's observations confirm this statement and at a future date he hopes to publish figures showing the results that can be obtained. The amount of silicon in the iron can also be considerably varied.

An important feature of the electrolytic process will no doubt be the introduction of some new ferro-alloys, which cannot be made by fusion. Alloys of iron and nickel have already been produced electrolytically. Electrolytic iron sheets can be obtained with a highly finished surface, can be readily welded, coated with tin and zinc by dipping in a molten bath of these metals, coated with zinc by the Sherardizing process, or electro-galvanized. The structure of electrolytic iron varies considerably; in some cases it is found to be amorphous, while in other instances it possesses a structure somewhat similar to that of wrought iron.

PROPERTIES OF ELECTROLYTIC IRON.—The properties of electrolytic iron appear to depend largely on the amount of hydrogen present, and therefore on the annealing, which reduces or eliminates the occluded hydrogen. Samples tested have given a hysteresis loss of under 0.3 watt per lb. The iron when charged with hydrogen is magnetic; and when magnetized, becomes a very powerful magnet as compared with ordinary steel. Electrolytic iron always contains hydrogen in varying quantities, according to the conditions under which it is deposited, and the more hydrogen it contains the greater is its hardness. The hardest varieties will scratch glass. Longheber has found electrolytic iron to contain 0.2 to 0.001% of hydrogen. Although these figures appear small when expressed as weight percentage, they represent volumes of hydrogen to iron of between 12 and 110. When high current densities were employed, deposits were obtained containing 110 times their own volume of the gas. Other investigators have obtained even larger percentages of hydrogen.

Electrolytic iron has a tendency, when deposited on a flat surface, to curve outwards—that is, it becomes concave relative to the anode surface when deposited on the cathode. There are two distinct varieties of electrolytic iron, with varying percentages of hydrogen; the softer kind of iron is silver-gray in color, while the other variety is very hard and brittle, breaking as readily as glass, and containing a higher percentage of hydrogen. The hardness varies between these two extremes. A surface can be obtained on the latter of a silvery whiteness, and with a mirror finish without polishing, as will be observed by the specimens exhibited. Either quality can

*Extracts from a paper presented at the September meeting of the Iron and Steel Institute.

†Grosvenor Mansions, Victoria St., London, S. W., England.

The velocity of the gases leaving the expansion nozzle for a compression ratio of 27 would be about 4,600 ft. per second, which is much higher than occurs in steam turbine practice. The effect of friction at such high velocities is yet to be determined. The experiments quoted by Professor Thomas in his book on Steam Turbines indicate that up to 220 lbs. per sq. in. pressure the percentage of friction loss in a properly shaped nozzle diminishes with increase of pressure. If this law continues, the use of high jet velocities may not detract from the efficiency.

It seems, therefore, within the range of possibilities to construct a gas turbine giving an efficiency of 60%, and a three-stage air compressor of 85% efficiency. Referring to Fig. 3, the combined efficiency for air dilution with intercooling is found to be 19.5%, and for water injection, 15%.

In Bulletin 191 of the U. S. Department of Agriculture, Lucke and Woodward detail tests of engines using gasolene and alcohol.* The smallest fuel consumption with gasolene was about 0.7-lb. of gasolene per brake-HP., obtained only with the most perfect adjustment in a very few tests. The average fuel consumption was nearer 1.25 lbs., which probably represents more nearly the average practice. A fuel consumption of 0.7-lb. of gasolene per horse-power corresponds to an efficiency of about 18%, while a fuel consumption of 1.25 lbs. of gasolene per horse-power hour corresponds to a fuel efficiency of 10%.

The gasolene turbine appears to offer advantages in reliability, comparative simplicity of adjustments, and freedom from annoying troubles as compared with the explosion engine. Whether it can compete with the latter in power developed per unit of weight remains to be determined. A further advantage which the gasolene turbine has over the explosion engine is that the gasolene turbine can burn crude oil, which is a cheaper fuel.

*See also Engineering News, March 12, 1908.

THE DULZURA CONDUIT OF THE SOUTHERN CALIFORNIA MOUNTAIN WATER CO.; EXTENSION OF SAN DIEGO WATER SUPPLY.

By M. M. O'SHAUGHNESSY,* M. Am. Soc. C. E.

The first portion of the extension of the Southern California Mountain Water Company's storage and conduit system,† for supplying the city of San Diego, Cal., is nearing completion. This is a 13-mile open conduit extending from the upper streams of the company's supply area to the valley of the Lower Otay Reservoir, whence a wood-stave pressure pipe-line leads to the city. The new aqueduct, the Dulzura Conduit, augments the Otay supply by the normal flow of the headwaters of Cottonwood River, but when the projected storage works on these upper streams are built, equalizing the variations of runoff, the conduit will bring their full flow down to the head of the pipe-line. The conduit as now built taps Pine Creek and Cottonwood Creek by low diversion weirs, as illustrated in Fig. 1 (Pine Creek intake), whereas in the full development there will be a 175-ft. storage dam on the Cottonwood, just below the junction of these two streams, supplemented by a 150-ft. dam on the upper course of the Morena. The Morena dam was built to a height of 100 ft. ten years ago, but has never been completed. The map Fig. 4 shows the entire territory covered by the projected works, and the location of the Dulzura Conduit. The existing works comprise the Upper Otay and Lower Otay Reservoirs, a 30-in. wood-stave pipe 20 miles long from the Lower Otay to the Chollas Heights distributing reservoir, and at the latter a 7,000,000-gal. New York pressure filter plant. Simultaneous with the construction of these works, the construction of two storage reservoirs in the mountains was begun, the Morena Dam and the Barrett Dam, which would give the system a capacity ample for a large future growth of San Diego, even through a period of several years of insufficient rainfall. Work was stopped, however, before the upper reservoirs were far advanced, and before anything had been done toward building a conduit to bring their storage to the city. In 1907 the project was again taken in hand actively, and as the first work the Dulzura Conduit was started. This is an essential element of the complete system, but also has a partial usefulness at once, in bringing the unequalized stream flow from the Cottonwood valley over the Dulzura divide into the valley of Otay Creek. Further, it will prove useful in another way during the building of the Barrett Dam, by diverting the stream-flow around the dam site, which the conduit passes in tunnel.

The relation of the entire system to the water supply of San Diego will be referred to again, following a description of the Dulzura Conduit work.

Work on the Dulzura Conduit was begun in August, 1907, and is to be completed by Jan. 1, 1909. The conduit is 13 mi. long, of which length about 3 mi. is above Barrett and 10 mi. below. Its average slope is 4 ft. per mile, and its minimum section 4 ft. 6 ins. by 3 ft. 10 ins. The carrying capacity of the conduit is estimated to be 40,000,000 gals in 24 hrs., when flowing full. The upper two miles are of somewhat larger section, 6 ft. by 4 ft. 6 ins. minimum, the capacity of this portion being about 80,000,000 gals. in 24 hrs.

The intakes are each about half a mile above the junction of Cottonwood Creek and Pine Creek. The Pine Creek intake is a concrete dam which virtually continues the river wall of the conduit upstream and across to the opposite bank. The Cottonwood intake is of simpler construction.

That part of the conduit which lies above the Barrett dam site is mostly canal, with a few short flume sections, and a flume carried on trestle and trusses across Pine Creek. At Barrett is the first tunnel, bypassing around the dam site. From the dam south, canal, flume and tunnel alternate as the topography makes necessary. The tunnels number 17, from 40 ft. to 2,060 ft. long, aggregating over 9,000 ft. Of the entire length of conduit, the following portions are canal, tunnel and flume respectively:

Concrete-lined canal	53,446 ft.
Tunnel	9,154 ft.
Flume	5,000 ft.
Total	67,600 ft.

The canal portions are designed with trapezoidal section, 6 ft. wide at top, 4 ft. wide at bottom, and 4 ft. deep below top of coping. The

*Chief Engineer, Southern California Mountain Water Co., San Diego, Cal.

†A full description of the system, with location map, drawings of the principal structures and numerous views, appeared in Engineering News April 7, 1904, pp. 335 et seq. The map shown as Fig. 4 of the present article is reproduced from that issue, with several additions.

FIG. 1. DIVERSION DAM AT HEAD OF DULZURA CONDUIT ON PINE CREEK.

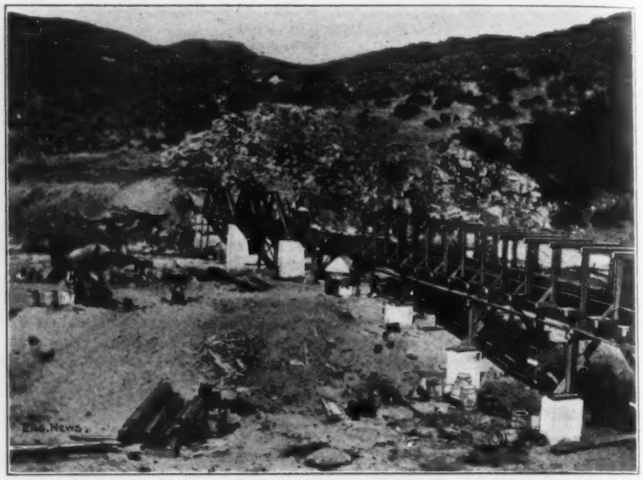

FIG. 2. TRESTLE APPROACH AND BRIDGE FOR FLUME, PINE CREEK CROSSING (PARTLY COMPLETED).

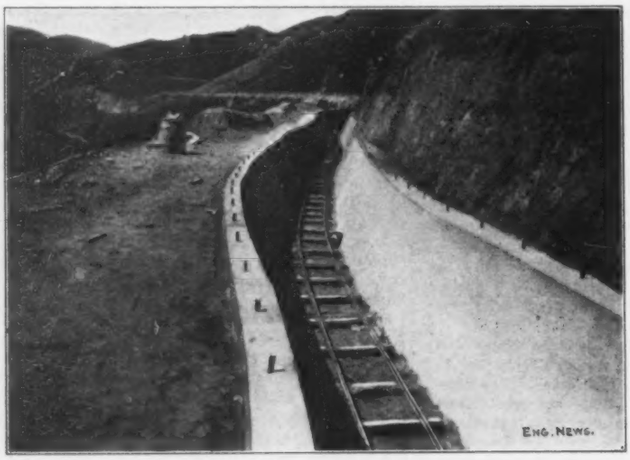

FIG. 3. CONCRETE-LINED CANAL.
[A reinforced-concrete cover is to be built over the canal later, to keep out debris and prevent vegetable growth.]

FIGS. 1-3. PINE CREEK INTAKE, BRIDGE FOR FLUME OVER PINE CREEK, AND SECTION OF CONCRETE-LINED DITCH; DULZURA CONDUIT OF SOUTHERN CALIFORNIA MOUNTAIN WATER CO.
[Water Supply of San Diego, Cal.]

$$\text{Eff.} = \frac{C_p(T_2 - T_1) - C_p(T_3 - T_4)}{C_p(T_2 - T_1)}$$

$$= 1 - \frac{T_3 - T_4}{T_2 - T_1}$$

From the adiabatic relation,

$$\frac{T_1}{T_4} = \rho^{\frac{\gamma - 1}{\gamma}} = \frac{T_2}{T_3}$$

Consequently,

$$\text{Eff.} = 1 - \frac{T_4}{T_1} = 1 - \rho^{\frac{1-\gamma}{\gamma}}$$

with a considerable excess. If a sufficient excess of air is used the temperature of the gases when they strike the turbine blades can be brought down to a value for which the strength of steel retains a high value.

When practical efficiencies are considered, however, it is found that the proportion of air to fuel becomes important. Of the theoretical power that can be developed, only a fraction is actually converted into mechanical power. Consequently a much larger proportion of the available power must be consumed in compressing the air than is allowed in the theoretical expression for efficiency. The greater the proportion of air to fuel, the more will the practical efficiency fall off from the theoretical. The question arises whether with practicable mechanical efficiencies for the turbine and the compressor a sufficient excess of air can be used to bring down the temperature of the gases to a proper value and still give a reasonable efficiency for the complete operation.

The velocity stage type of turbine seems best suited for use as a gas turbine. The gases may be expanded completely in a nozzle of refractory material down to their lowest temperature before striking the wheel. The calculations which follow will be limited to this type of turbine.

The formula for theoretical efficiency indicates that high compressions are favorable to efficiency. To produce high compressions it is practically necessary to use two-stage or three-stage compressors. It occurred to the writer that it might be an advantage to use intercoolers between the stages of such compressors. Calculations have accordingly been made for the purpose of comparing the efficiencies obtainable with intercoolers and without them, with the general result, as shown in the tables, that while theoretically the best efficiency is obtained by adiabatic compressions without intercoolers, yet with such values as are practically obtainable for the mechanical efficiencies of turbine and compressor the use of intercoolers is decidedly advantageous.

Calculations have been made for a two-stage compressor having total compression pressure ratios of 9 and 16, and for a three-stage compressor with a ratio of 27. The letter *a* is used when the compression is completely adiabatic, the letter *c* when the compression is adiabatic in each stage but the air is cooled between stages, and the letter *w* when water is injected.

It is assumed that the temperature of the air entering the compressors is 531° F. absolute, and also that each intercooler reduces the air to 531° absolute. The pressure of the air at the beginning of the compression is assumed to be 14.7 lbs. per sq. in. absolute, and the temperature of the gases leaving the expanding nozzle is assumed to be 1,200° F. absolute, at which temperature the tensile strength of steel is about 10% less than at ordinary temperatures. It is assumed that the fuel used is a gasolene containing 15% hydrogen and 85% carbon, and that its calorific value is 20,000 B. T. U. per lb. The work required to force the gasolene into the compressed air is relatively small and has been neglected.

The value of γ taken was 1.4 for the air during compression. For the gases during expansion γ has been taken as 1.39. The value of the specific heat at constant pressure is taken as 0.2375 for the air and 0.25 for the gases.

The following is a sample calculation for a two-stage compressor with a pressure ratio of 3 in each stage:

Maximum pressure = 14.7 × 9 = 132.3 lbs. per sq. in.

(*a*) $T_1 = T_4 \times \rho^{2/\gamma} = 531 \times 9^{2/\gamma} = 995°$ abs.

(*c*) $T_1 = 531 \times 3^{2/\gamma} = 727°$ abs.

$T_3 = 1{,}200°$ F. abs.

$$T_2 = 1{,}200 \times \frac{.39}{91.39} = 2{,}225°.$$

(*a*) Heat given to 1 lb. of gases = .25 (2,225 − 995) = 307 B. T. U.

Gasolene used per lb. of air = 307/20,000 = 0.015 lb.

Heat given to 1.105 lbs. of gases = 312 B. T. U.

(*c*) Heat given to 1 lb. of gases = 0.25 (2,225 − 727) = 374 B. T. U.

Gasolene used per lb. of air = 0.019.

Heat given to 1.019 lbs. of gases = 381 B. T. U.

(*a*) Heat equivalent of work required to compress 1 lb. of air = 0.2375 (995 − 531) = 110 B. T. U.

(*c*) Heat equivalent to compress 1 lb. of air = 0.2375 (727 − 531) × 2 = 93 B. T. U.

(*a*) Heat equivalent of work derived during expansion of 1.015 lbs. of gases = 1.015 × 0.25 (2,225 − 1,200) = 260 B. T. U.

(*c*) Heat equivalent of work derived during expansion of 1.019 lbs. of gases = 1.019 × 0.25 (2,225 − 1,200) = 261 B. T. U.

(*a*) Heat required to vaporize 0.015 lb. of gasolene and heat it from 531° to 995° = [.5(995 − 531) + 240] × 0.015 = 472 × 0.015 = 7 B. T. U.

(*c*) Heat required to vaporize 0.019 lb. of gasolene and heat it from 531° to 727° = 0.019 × [0.5 (727 − 531) − 240] = 338 × 0.019 = 6 B. T. U.

(*a*) Theoretical efficiency $= \frac{260 - 110}{312 + 7} = 0.47.$

(*c*) Theoretical efficiency $= \frac{261 - 93}{381 + 6} = 0.43.$

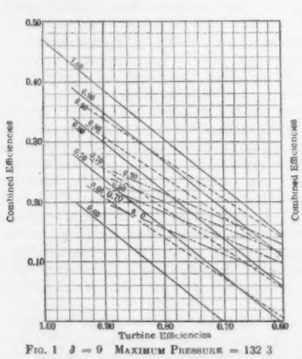

FIG. 1 $\rho = 9$ MAXIMUM PRESSURE = 132.3

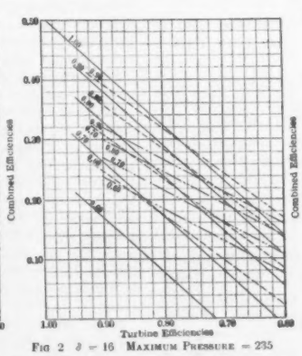

FIG. 2 $\rho = 16$ MAXIMUM PRESSURE = 235

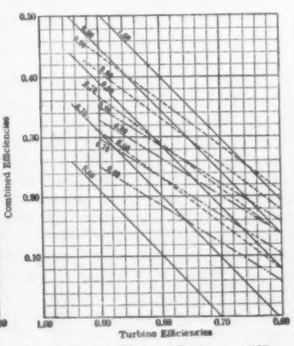

FIG. 3 $\rho = 27$ MAXIMUM PRESSURE = 397

DIAGRAMS SHOWING THEORETICAL EFFICIENCY OF GAS TURBINE UNDER VARIOUS CONDITIONS.

For a mechanical efficiency of the turbine of 0.65 and of the compressor of 0.85, the combined efficiencies will be:

(*a*) Eff. $= \frac{0.65 \times 260 - 110 \div 0.85}{319} = 0.13.$

(*c*) Eff. $= \frac{0.65 \times 261 - 93 \div 0.85}{387} = 0.16.$

The corresponding calculation for water cooling follows. The heat absorbed by the injected water has been calculated from the values for the specific heat of superheated steam given in a recent paper by Professor Thomas:

Temperature at end of compression (*a*) = 995°.

Temperature at end of compression (*c*) = 727°.

Allow 19 lbs. of air to 1 lb. of gasolene.

Theoretical temp. of gases after burning

(*a*) $= \frac{20{,}000 - 472}{20 \times 25} + 995 = 4{,}900°.$

Theoretical temp. of gases after burning

(*c*) $= \frac{20{,}000 - 338}{20 \times 25} + 727 = 4{,}659°.$

Temperature at beginning of expansion = 2,225°.

B. T. U. required to convert 1 lb. of water at 70° F. into superheated steam at 2,225° and 132.3 lbs. pressure = 1,188.2 − 38 + 142 + 0.47 (2,225 − 1,079) = 1,830.

Water required per pound of gas

(*a*) $= \frac{(4{,}900 - 2{,}225) \times 0.25}{1{,}830} = 0.37.$

Water required per pound of gas

(*c*) $= \frac{(4{,}659 - 2{,}225) \times 0.25}{1{,}830} = 0.33.$

Work done by 1 lb. of gas = 256 B. T. U.

Temperature of steam at end of expansion = 2,225 ÷ $0.9^{0.3/1.3}$ = 1,340°.

Work done by superheated steam (*a*) = 0.37 × 0.47 (2,225 − 1,340) = 154 B. T. U.

Work done by superheated steam (*c*) = 0.33 × 0.47 (2,225 − 1,340) = 138 B. T. U.

Heat furnished by 1/20 lb. of gasolene = 1,000 B. T. U.

Eff. (theoretical)

(*a*) $= \frac{256 + 154 - 19/20 \times 110}{1{,}000} = \frac{410 - 105}{1{,}000} = 0.305.$

Eff. (theoretical)

(*c*) $= \frac{256 + 138 - 19/20 \times 93}{1{,}000} = \frac{394 - 88}{1{,}000} = 0.306.$

A calculation of the total efficiencies for various efficiencies of turbine and compressor shows that a combination of water injection and intercooling gives a slightly higher total efficiency than water injection without intercooling. It is not probable that both would be used in the same machine and consequently the calculations have been limited to the case of water injection with true adiabatic compression.

The results have been arranged in the form of tables and also plotted in the accompanying diagrams. If the turbine efficiencies be chosen as abscissas and the total efficiencies as ordinates, then for a fixed compressor efficiency the relation will be expressed by a straight line. Lines have been drawn representing compressor efficiencies of 90, 80, 70 and 60%. Full lines represent cooling by excess of air and true adiabatic compression; dotted lines, cooling by excess of air and cooled compression; broken lines, cooling by water injection and adiabatic compression.

An inspection of these diagrams shows that for all values of the mechanical efficiencies that seem obtainable at present, true adiabatic compression gives a lower total efficiency than either intercooling or water injection.

It also appears that water injection gives a higher efficiency under some conditions than air dilution, while under other conditions the reverse is true. The diagrams show this very clearly. The slope of the total efficiency lines is such that the total efficiency line for water injection corresponding to a certain compressor efficiency may intersect the line for air dilution with intercooling corresponding to the same compressor efficiency. For instance, in the diagram for a compression ratio of 16, the total efficiency line for water injection corresponding to 70% compressor efficiency crosses the 70% line for air dilution with intercooling at 74. Consequently, when the compressor efficiency is 70%, the total efficiency for water injection is less than for air dilution with intercooling if the turbine efficiency is greater than 74%. If the turbine efficiency is less than 74%, water injection shows the greater efficiency.

Comparing the diagrams for different compression ratios, not only are the total efficiencies greater for the higher pressures, but the relative effects of the different methods employed for keeping down the temperature of the gases upon the total efficiencies change decidedly. For instance, in the diagram for $\rho = 16$, the 70% lines for water injection and for intercooling intersect at a turbine efficiency of 74%, while in the diagram for $\rho = 27$, the corresponding lines do not intersect within the limits of the diagram, showing in the latter case that air dilution with intercooling is the more efficient for all values of turbine efficiency included in the diagram.

The air used per pound of gasolene in the different cases is as follows:

For $\rho = 9$ condition (*a*)	66 lbs.
For $\rho = 9$ condition (*c*)	52 lbs.
For $\rho = 16$ condition (*a*)	52 lbs.
For $\rho = 16$ condition (*c*)	43 lbs.
For $\rho = 27$ condition (*a*)	47 lbs.
For $\rho = 27$ condition (*c*)	34 lbs.
For all values of ρ (*w*)	19 lbs.

What can be expected of the gasolene turbine in practice?

Air compressors of the piston type have been constructed which give a mechanical efficiency of 85%. The best mechanical efficiency obtained with steam turbines is in the neighborhood of 65%. Whether a velocity stage gas turbine of equal efficiency is possible can only be determined by actual trial. Some of the points of difference are as follows:

In the steam turbine, the wheel revolves in gaseous mediums varying from a considerable density at the higher pressures to a very small density in the vacuum at the exhaust end. In the gas turbine, the gaseous medium is at atmospheric pressure, but on account of its high temperature the density will be only a little more than a third of that of air under ordinary atmospheric conditions. It is quite possible that the wheel friction will be no greater on the whole for a gas turbine than for the best steam turbine.

by installing a central power-plant in a valley about 600 ft. below the conduit and about 4,000 ft. distant. They put in a 50-HP. gasoline-engine compressor and used a 2-in. pipe to carry the air. This plant was very expensive and inefficient. Last February they supplemented this with a 75-HP. gasoline-engine and compressor, and since then have had an abundance of air.

The miners drill in each 24 hrs. a round of 12 to 14 holes about 4½ ft. deep. They get $5 a round per man, with a bonus if they make over 100 ft. a month. Seventy-five pounds of No. 2

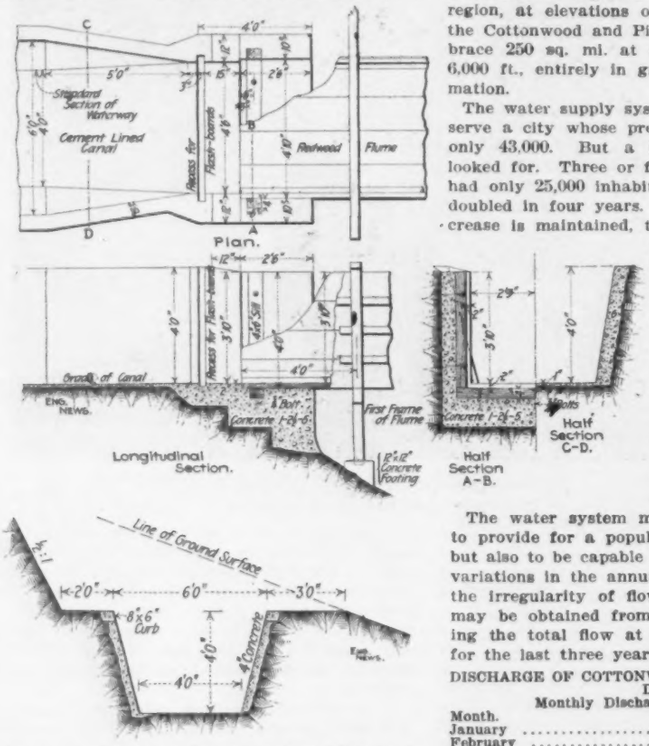

Fig. 6. Typical Cross-Section of Ditch with Junction Details of Timber Flume and Concrete-Lined Ditch, Dulzura Conduit.

(40%) giant-powder is used for a round, averaging 18¾ lbs. per ft. The muckers get $1.50 per ft. for mucking. Three barrels of gasoline distillate, 110 gals. each, are used per day to drive two compressors, a cost of $3 per ft. for power alone.

The cost per foot to the contractors at the present would, therefore, be as follows:

80 ft. of fuse		$0.400
18.75 lbs. powder		2.625
13.3 caps		0.080
25 candles		0.300
Ammunition, cost per ft.		$3.405
2 miners at $5 for 4 ft.	$2.50	
Mucking	1.50	
Gasoline	3.00	
Engine labor and incidentals	2.00	
Track equipment	1.00	
Labor and power cost		10.000
Total cost per foot of tunnel		$13.405

Their contract price for all tunnels was $13 per lin. ft., and for ditch excavation 75 cts. per cu. yd., which included all materials without classification.

A peculiar kind of granite was experienced at some points, especially in the north end of Tunnel 4, where the holes often had to be shot three times before the rock would break. The rock seemed to be of a peculiar soft and tough composition. In many months only 80 or 90 ft. were made at each end of the tunnels, working two shifts, with machine drilling. The rock has later gotten harder and more crystalline and breaks much better.

The Southern California Mountain Water Company's extensive system, of which the Dulzura Conduit forms part, supplies an exceptionally pure water from unpolluted mountain sources at the phenomenally low rate of 4 cts. per 1,000 gals.,* which eclipses in cheapness all other supplies in the United States, notwithstanding the fact that San Diego occupies the most arid position of the west-coast cities. The company controls 350 sq. mi. of mountain area lying in elevations from 400 to 6,000 ft. above sea-level and consisting mostly of granite rock from which the water flows pure and free from contaminating salts.

The Otay drainage-area, about 20 mi. southeast of San Diego, occupies 100 sq. mi. of this region, at elevations of 400 to 1,000 ft., while the Cottonwood and Pine Creek watersheds embrace 250 sq. mi. at elevations from 1,600 to 6,000 ft., entirely in granite and porphyry formation.

The water supply system is designed solely to serve a city whose present population numbers only 43,000. But a large future increase is looked for. Three or four years ago San Diego had only 25,000 inhabitants, having thus nearly doubled in four years. If the same rate of increase is maintained, the 100,000 point may be reached well before ten years from now. San Diego's popularity as a health resort, and its commercial importance after completion of the Panama Canal—it being the nearest American port, and having an excellent land-locked harbor 1 mi. wide by 12 mi. long—will undoubtedly cooperate to produce a steady growth.

The water system must be planned not only to provide for a population of at least 100,000, but also to be capable of equalizing considerable variations in the annual rainfall. Some idea of the irregularity of flow of the available water may be obtained from the following table giving the total flow at Barrett Dam by months for the last three years:

DISCHARGE OF COTTONWOOD CREEK AT BARRETT DAM.

Monthly Discharges in Acre-Feet.

Month.	1906.	1907.	1908.
January	953	8,321	2,029
February	1,340	3,981	4,501
March	36,500	8,725	3,018
April	10,500	6,075	1,328
May	3,380	3,257	777
June	1,820	1,653	....
July	738	251	....
August	369	77	....
September	77	68	....
October	184	464	....
November	1,210	528	....
December	4,970	606	....
Year's total	62,000	34,000	11,653

Thus, the total flow of Cottonwood Creek at Barrett Dam in 1907 was only half as much as that in 1906, and the aggregate flow for 1908 promises to be less than half the smaller figure, or only one-fourth of the 1906 flow.

The 1907 discharge is equal to a mean daily flow of 30,000,000 gals., which would supply a population of at least 200,000. It is thought that this will be ample for perhaps 20 years in San Diego. The capacity of the Dulzura Conduit, it will be noted, is in excess of this figure.

To make the entire mean flow available, however, the storage capacity of the reservoirs must be sufficient to equalize not only the monthly but also the annual variations. How the projected works accomplish this may be seen from the following list of storage capacities:

Reservoir.	Capacity in gallons.
Upper Otay	65,000,000
Lower Otay	11,000,000
Morena	15,000,000,000
Barrett	15,000,000,000
Total	42,350,000,000

This would be sufficient to supply ten million gallons per day for over ten years, if the entire contents of all reservoirs could be utilized. The intention of the projectors was to provide sufficient storage to tide over dry periods of as much as 7 yrs.

The Southern California Mountain Water Co. began the simultaneous development of the complete system about 12 yrs. ago, under the administration of Mr. E. S. Babcock as President, General Manager and Chief Engineer. After the Otay supply was developed and some $250,000 spent on the Morena dam, work was suspended. In 1907 Mr. John D. Spreckels, of San Francisco, secured entire control of the company, and since then an active policy of expansion has been prosecuted, with Mr. Spreckels as President, Mr. Wm. Clayton as Vice-President, and Mr. H. L. Titus as Attorney. The writer, as Chief Engineer of the company, is in charge of all the extension work. Mr. J. S. Molony, M. Inst. C. E., was Resident Engineer during the period of construction, and Mr. R. Wueste was Assistant Engineer.

After the completion of the Dulzura Conduit, the Morena and Barrett dams will be taken in hand. The former is a rock-fill structure 150 ft. high, the latter a masonry 175 ft. high. Exploratory work on the foundations of the Barrett dam is now progressing, without regard to the existing work there, as it is desired to proceed on a basis of full knowledge and security as to the foundation. This dam is estimated to cost over $500,000 and will take at least two years to complete.

*The city owns the distributing pipes within the city and distributes the water, the company selling the water wholesale to the city.

THE WORCESTER TRADE SCHOOL PLAN.

By E. H. FISH.*

The Worcester plan for a trade school, which was proposed last June by a commission appointed to investigate such matters, so impressed the writer that he has since spent much time studying the plan, the men who made it, and the people whom it is expected will profit by it.

In setting down what impressed him, he cannot help following in some degree the line of the editorial at p. 308 of the present volume of Engineering News.

The matter of the establishment of the school is, at the present writing, before the city government. From personal acquaintance with that body, the writer feels safe in saying that the plan will pass on its merits unless it is sacrificed to some unforeseen log-rolling scheme. If it does not pass, it still remains true that in the report of this commission we have a simple, rational and equitable plan for the education of boys to a useful purpose, and a plan which is large enough in its scope to be applicable to other trades besides that of the machinist, and to girls as well as boys.

The plan provides for a school under the control of a board of trustees, independent of any

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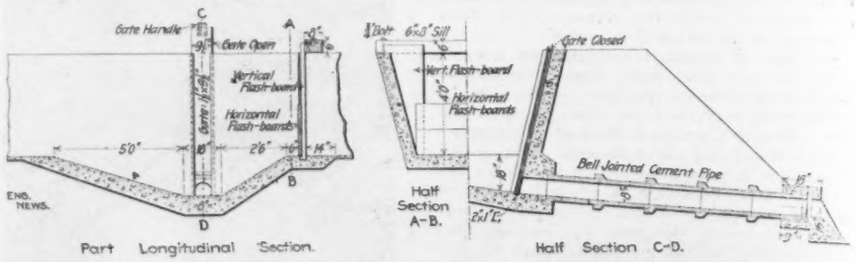


FIG. 7. SAND TRAP IN CONCRETE-LINED DITCH, DULZURA CONDUIT.

canal has a concrete lining throughout, of thickness depending on the character of excavation, with a maximum of 6 ins. The sketch Fig. 6 shows the typical canal section. The side walls in all cases are finished off with a 6 × 8-in. concrete coping, in the top of which are cored holes for anchoring a future extension 6 ins. high to carry a reinforced-slab roof (see Fig. 3).

The canal is replaced by timber flume only where the grade line crosses depressions. Fig. 5 gives typical details of the flume and the supporting trestle. The trestle-work is of pine, on concrete footing blocks (except in a few places where wooden mud-sills are used). The flume itself is of redwood. It is of rectangular section, 4 ft. 6 ins. × 3 ft. 10 ins. inside. The lining is 2-in. plank; the frames, spaced 4 ft. apart, have 3 × 4-in. tie-timbers across the top, notched over the posts. The view, Fig. 2, of the bridge and trestle crossing over Pine Creek a mile above Barrett gives a good idea of the flume work (uncompleted flume), though in this part the section is larger than below Barrett, being 6 ft. × 4 ft. 6 ins. inside the lining. The trusses of the two spans over Pine Creek have clear spans each of 40 ft.; they are Howe trusses, 7 ft. 10 ins. c. to c. chords, and differ from the ordinary Howe details in having the diagonals spiked to the sides of the chord beams instead of being butted against cast bevel-blocks.

The tunnels of the conduit are generally in very hard rock, granite, syenite, porphyry, etc., and no seepage is expected, so that, as the section considerably exceeds the section of the open canal, no smooth lining is being placed for the present. Timbering is used at the entrances in many cases. This comprises roof and side sheeting of 2-in. plank held by inside frames 3 ft. apart. The frames consist of a 4 × 6-in. cross sill and 6 × 6-in. posts and roof timbers. The roof timbers are a cap 3 ft. 6 ins. long and two inclined struts 2 ft. 6 ins. long. The clear section inside the frames is 6 ft. wide, 5 ft. high to base of inclined struts, and 6 ft. 6 ins. high to cap timber.

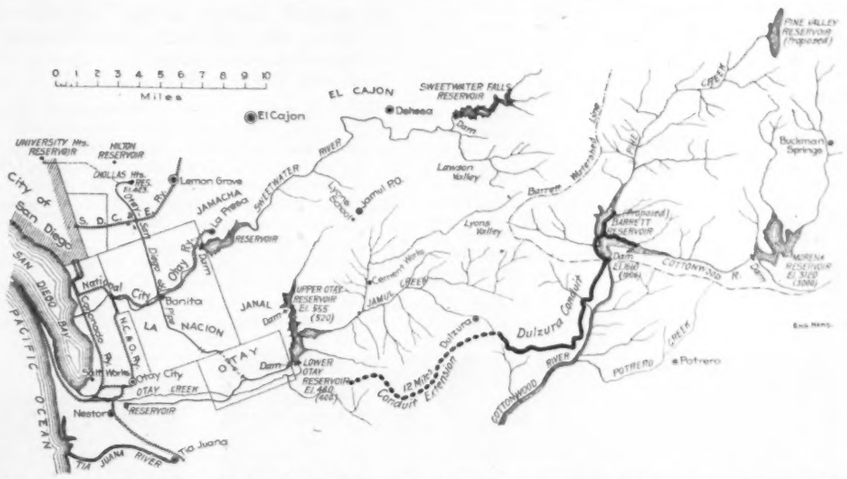
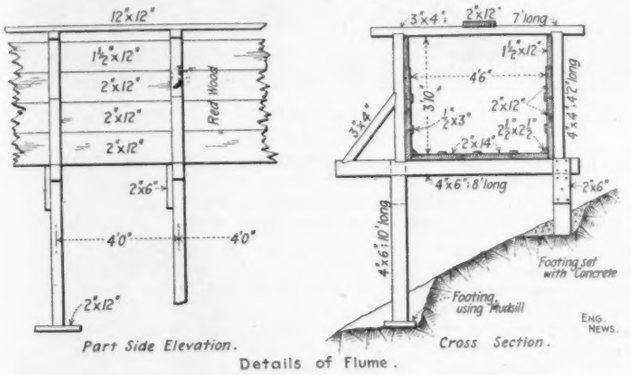
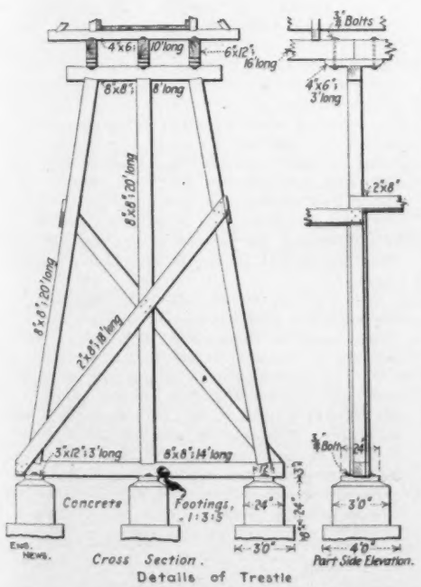


FIG. 4. MAP OF FULL DEVELOPMENT OF SOUTHERN CALIFORNIA MOUNTAIN WATER CO.'S SYSTEM, SHOWING LOCATION OF DULZURA CONDUIT.

(Elevations given at reservoirs are for top of dam; elevations in parentheses are for bottom of outlet tunnel.)



Details of Flume.



Details of Trestle

FIG. 5. TYPICAL FLUME CONSTRUCTION, DULZURA CONDUIT.

For the construction of the conduit it was necessary to build a wagon-road 9 mi. long from the Dulzura divide to the Barrett dam site, as all transportation had to be by teaming from La Presa, and no suitable road existed. Some $50,000 was spent in building this road, grading it to 5% maximum grades and providing a granite-macadam surface. Both the company and the contractor have large numbers of 6 to 10-horse teams constantly moving over this road hauling supplies. Even with the help of this road, however, the haulage makes up a very large item of the cost of work, as may be judged from the fact that it costs $3.75 a barrel to bring cement from San Diego to the Barrett dam.

About 5 mi. of the conduit is being excavated by the company. The other 8 mi. were let to Robert Sherer & Co., of Los Angeles. The contract includes 11 tunnels, while six are driven by the water company. In the canal portions, the contract includes only excavation, the concrete lining work being all done by the company.

The concrete lining of the canal is put in by day's work with small concrete gangs in first-class manner. The cement is hauled from San Diego, costing about $7 per barrel delivered on the work. The sand is picked up from the river bed and washed, and hoisted by cables to different distributing points along the ditch. The concrete lining of the ditch averages about 4 ins. thick, the top curb being 8 × 6 ins., on which the roof slab will afterwards rest. It takes about one barrel of cement to every 7 lin. ft. of ditch. The concrete is proportioned 1 of cement to 3 of sand and 5 of crushed rock or gravel; this makes a very good mixture. The ditch cuttings, which are entirely in excavation, have developed many good beds of granite, which makes a very good material for concrete.

To counteract temperature cracks expansion joints are made 12½ ft. apart, as follows: Strips of deadening felt 2 lbs. per yd. are placed in the concrete between two guide slats which are gradually removed as the concrete is poured in and tamped from the top. Since adopting this method practically no cracks or deterioration is shown in the concrete. The temperature strains are very great, owing to a variation of practically 70° a day in the thermometer in the sun at some seasons in the year.

For forms, arched braces of 2 × 4 ins. are used on 4-ft. centers and are joined and braced on top to leave clearance for mules to do the tramming. The lagging used is 1 × 6-in. surfaced pine made into panels 2 ft. × 16 ft., which interlock and are movable. The forms are removed about two days after the concrete (which is poured quite liquid) is placed.

The most economic means of handling the concrete has been found to shovel from the mixing platforms into boats on cars, tramming the material both ways from the central stations, and shoveling from the cars into the forms.

Some data as to the cost of the tunneling operations on this conduit may be useful.

Tunnel No. 1, 1,200 ft. long, passing through the ledge on the west side of the Barrett dam site and destined to form also the permanent outlet tunnel of the Barrett reservoir, was driven entirely by hand drilling. This is part of the Sherer contract, and has just been completed. The location is isolated, on the side of a steep rock hill, so that bringing in water and supplies for a machine plant would be very difficult, and the contractors decided to drive by hand.

Some Arizona miners took the subcontract from Sherer & Co. at $15 per ft. for the labor; track, cars, powder, fuse, caps and candles were furnished them free. The formation on the outside was rather mixed, but the inside, after 100 ft. at each end was driven, proved to be the hardest kind of syenite and quartzite. I think those miners were the best hand drillers I ever saw. They worked in two 8-hr. shifts, allowing four hours after shooting for the powder smoke to go out. Two men in one 8-hr. shift usually drilled 10 ft. of hole: in other words, they made about ten holes a foot long. They drilled singlehandled with 4-lb. hammers, using per foot of tunnel about 4 lbs. of powder, 2 lbs. of candles, 13⅜ caps and 30 ft. of fuse. They used ⅞-in. drills and each shift dulled about 100 drills.

Their ammunition cost a little less than $2 per foot of tunnel. Other hand drilling, done by the water company, in softer granite, showed the following results:

COST OF AMMUNITION, PER FOOT OF TUNNEL.	
39 ft. fuse, $5 per 1,000	$0.195
13-3/10 caps, 60 cts. a box	.080
15-3/10 lbs. powder, 14 cts. per lb.	1.142
1-4/10 lbs. candles, 12 cts. per lb.	0.168
Total ammunition cost per ft.	$2.585

Most of the other tunnels under contract were drilled with air drills. The contractors started

finds that his mental caliber is greater than he expected, there is always the technical college. The trade school ought not to be used as a fitting school for these colleges, but it ought to serve as a weeding-out school in the reverse sense to that usually used. That is, out of the large number of applicants which such a school will be sure to have, it should be possible to find a reasonable number capable of making good machinists, many capable of becoming exceptionally fine workmen and a few capable of developing into foremen, superintendents and engineers. Leaving aside all question of whether the best engineer is shop made or school made, it would seem to be the province of a trade school to keep itself clear of all technical school leanings and affiliations since otherwise there is danger of trying two experiments at once, and hence not being able to tell which is the success.

It is to be hoped that if this school is started in Worcester it may expand until it offers courses in many other trades. For unless a municipality intends to offer equal advantages to young people for all the trades that are largely practiced therein, it has no logical basis for offering advantages to any; and unless equal facilities are offered in many trades, there must necessarily result an overcrowding of the few for the reason that many boys will become students merely because they consider that it will pay and not because they themselves have any special liking or fitness for those particular trades. The plan of the school is broad enough to cover all the trades which are fully practiced in Worcester, and if the results of the canvass of the city made by the State Commission are dependable, there are some 2,500 or more children whose parents would prefer to send them to some school of the kind suggested by the commission rather than to the regular high school. This number is in excess of the number now enrolled in the high schools of the city. The plan proposed in Fitchburg would not be applicable to many trades, particularly those whose practice is dependent on the weather, and in many others it would not be easy of application.

As to the putting of boys to work steadily, the Worcester plan involves the securing of the boy's time for eight hours per day for eleven months in the year. The schedule of shop and studies, however, shows that of this time only about half is to be devoted to shop work, and of the balance a considerable part is allowed for study which may be done evenings, thus leaving a considerable amount of time for play by daylight. By calling for a definite amount of time it will be possible to better regulate sports than can be done in college, where faculties usually claim that they are not responsible for the acts of students out of school hours. I understand that during the heated term it is proposed to reduce the class room studies in favor of recreation. The control of the student's time will not be in the hands of men interested in them from a profit-making standpoint, which makes it more certain that their general health and mental condition will be carefully watched.

THE WORLD'S LARGEST CHIMNEY: 50 × 506-FT. BRICK STACK FOR THE BOSTON & MONTANA SMELTER AT GREAT FALLS, MONT.

On Oct. 23, 1908, a chimney of unprecedented size was topped out. This is a stack 506 ft. high above top of foundation ring and 50 ft. in interior diameter at top, at the smelter plant of the Boston & Montana Consolidated Copper & Silver Mining Co., about three miles from Great Falls, Mont. It is not only the highest in the world by some 40 ft., and the highest in America by 140 ft. (Eastman Kodak Co. chimney 366 ft., Orford Copper Co. chimney 365 ft.), but also by far the largest in capacity. With a draft of 3¼ ins. water (expected with gases at 600° F. average) its great diameter will give a discharge capacity of 4,000,000 cu. ft. of gases per min.

This chimney stands at a base elevation of 3,549 ft. above sea-level, so that its top is 4,055 ft. in elevation. The Alphons Custodis Chimney Construction Co., of New York City, designed and built it. The first brick was laid on the finished concrete foundation on [illegible] 7, 1908, and on Oct. 23 the shell was completed. Work is now in progress on the interior heat-protective lining and the large flue, 2,000 [illegible] long, for conducting the gases from the smelter to the chimney.

REQUIREMENTS.—The existing stack, [illegible] ft. high, has insufficient capacity for the needs of the smelter. The plant, with its most recent extensions, when working at its maximum capacity, may produce as much as 2,000,000 cu. ft. of gas per min. (about three times the discharging power of the old stack), and with a view to growth a chimney of double this capacity was desired.

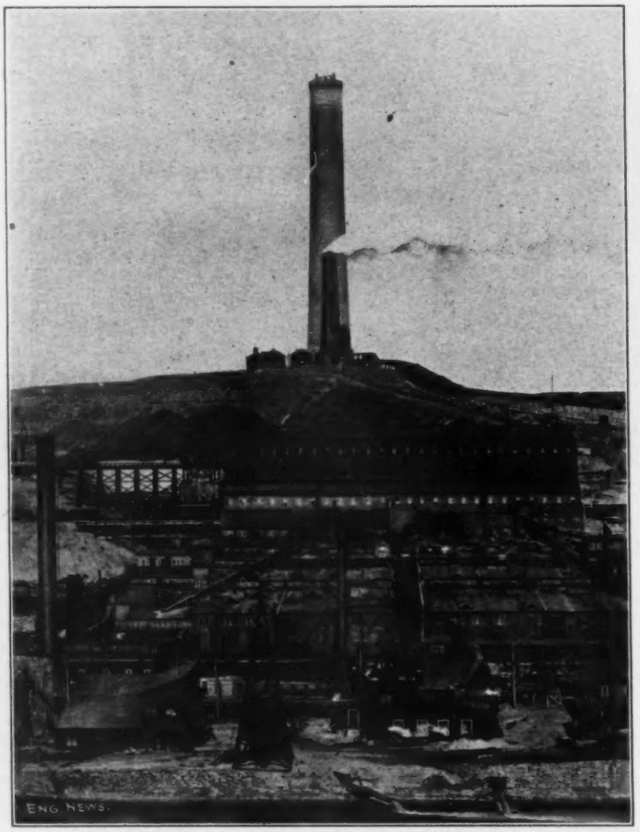


FIG. 1. THE GREAT FALLS SMELTER PLANT, AND THE OLD AND NEW CHIMNEYS.
(By telephoto view across the Missouri River Valley.)

The old chimney had suffered severely from the corrosive action of the acid gases, and the new chimney was therefore required to be proof against the action of acids. The smelter gases contain much sulphur dioxide, and while when dry the gases do not act even on exposed steel, when moisture is present sulphurous and sulphuric acid form, which attack even the ordinary brick. Careful selection of materials, however, makes possible the production of bricks proof against acid corrosion.

A height of 500 ft. above the general level of the upland on which the old chimney stands was selected as the desired height of the new stack; this was equivalent to 506 ft. above base of brickwork, at the particular point chosen for the structure. The height was governed solely by the draft requirements, and not by the desideratum of discharging high enough in the air to prevent creation of a nuisance; for, the valley bottom being 250 to 300 ft. lower and the city of Great Falls some 500 ft. lower than the tableland, even the old stack had discharged at a height sufficient for this purpose. The new stack was to be designed for a future increase of height of 60 ft. above the initial 506 ft., so that a still stronger draft may be secured if found necessary later on.

Very high winds occur frequently at the site of this chimney. Their possible effect on the structure is augmented by its exposed location and its height above ground. The owners there-

Fig. 2. Foundation Pit.
(Frames for concrete forms in position.)

Fig. 3. Top of Completed Concrete Foundation.
(Inside diameter of concrete at top, 64 ft. Outside octagonal, 81 ft. across flats.)

Fig. 4. Gutter and Drain-Spout Outside of Chimney Foundation.
(A 30-in. gutter, 12 ins. deep, is molded in the concrete along the outer edge of the foundation to carry off the large quantities of water which may run down the face of the stack in a driving rain.)

FIGS. 2 TO 4. THE FOUNDATION OF THE 506-FT. GREAT FALLS CHIMNEY.

...r school, and one which shall be largely ... Not that the shop is everything, but that ... best training for life is life, and to train a ... for shop life in anything but a shop is like ...ing him to learn to swim without water. ... shop is to be the center from which all in-...truction radiates. Mathematics is to be the ...ong point of the school room work. Arith-...tic is to be reviewed with especial care to ...e problems from shop work which shall have a technical value in addition to their value in pure mathematics. The boys will be taught the computation of gear ratios, change gears, set-over for tapers, etc., and the arithmetic necessary for use in cost and bookkeeping, including percentage and interest. Algebra, geometry and simple triangles under trigonometry will be treated in the same way as subjects whose value for mental training is not belittled. Physics is scheduled to be carried through nearly the whole course, and, as I understand it, is to be begun in a very simple way, covering the whole range by picking out parts easily understandable by a boy of 14 or 15, and working more and more into the mechanics of framework and machinery, nowhere approaching technical college work in mechanics or mathematical physics, but gradually impressing the student with the power of the laws of nature and with his own power if he will work in harmony with them. The practical side of physics will be illustrated by the use of the shop instead of a laboratory, abundant opportunity being there found for examples of the application of such laws as are of use to the workman in his daily tasks and in his future development.

The study of English accompanied by work in civics the first two years, history the second and political economy the third, is to consist of careful work in written and oral expression and the reading and study of the best of literature both technical and non-technical. This is the work which is to be depended on to broaden the student's mind both from a scholastic point of view by reading the fiction of the masters and from a technical viewpoint by reading such technical literature as the student may be able to comprehend, to the end that he may thereby realize the broad value of his trade and not narrowly imagine that all outsiders are barbarians. This course will comprise practically all that is included in the plan that will be purely scholastic, all the other class-room work being so closely interwoven with the shop work as to be more purely technical than the names may imply. To the writer's mind the fact that these subjects are to be so interwoven does not in any way decrease their value from the educational point of view. He believes that a young man may learn to think just as well over a problem in mechanics or physics as over Latin or Greek, and in fact better, because the students who would be attracted by a trade school necessarily will belong largely to the class who are inclined to detest the more scholastic studies, and who would probably not be attracted by the studies recommended except as they are made to appear necessary and closely related to their shop work.

In the drafting room and shop it is the desire of the commission that a commercial, shop atmosphere shall be approximated with a thorough teaching of the principles underlying the trade. So far as possible "exercises" are to be avoided as such, and for them will be substituted the making of commercial products or parts of machines which may be made to involve as close, careful work as it is wise for the student to attempt and which may, at the same time, be of such nature that even the unsuccessful work of the student is of practical use. For example, we will suppose that a student is given fifty collar screws of a given size to make. He will be told how such screws can be made economically and then told that he is to make this lot by job-shop methods for the sake of the skill which he may acquire. He will then pick out the right size stock, cut it off, center and square it up and turn the body to size to limit gages or to the micrometer, cut the thread to gages having much less than commercial limits and thus do all the work involved in making the screws under conditions which demand much better work than is necessary to make the product commercially usable. In this way he will gain skill and at the same time will not spoil a large amount of work. After a long enough period spent in doing such work to give him a degree of reliability and confidence he will be put upon the repair of used machinery and the making of new machines, thus learning the relation of parts and acquiring judgment as to the necessity of polishing this part or another and of the degree of nicety of fits required. Under the head of shop lectures, for which from two to five hours per week is allowed in the report of the commission, there is opportunity for instruction in such things as can be told by word of mouth better than by shop operation sheets or by individual help, and also for shop inspection about the city. The work in the blacksmith shop, pattern shop and molding room will follow the same general line.

If we grant the principle referred to in the editorial of Sept. 17 that "there should be taught in school first those things which can be secured elsewhere, or afterwards, not at all or only imperfectly," the question now arises whether the Worcester plan agrees with this principle.

In the school room work it may be suggested that the practical use of arithmetic has always been left to the pupil to pick up by experience. The same may be said of the other work in mathematics. Granted that this has been the case, why not ask how many have picked up the practical part compared with the number who are mentally able to do it? The one great arraignment against the Massachusetts public school system to-day is that it does not teach the useful application of the studies which it professes to offer.

In the shop course it may be said that it would be better to leave the final acquirement of skill, the habit of using tools carefully, till the student became employed on commercial work; to which the writer would reply that in his opinion the boy who is sent out of a school provided only with a training which has taught him how a job ought to be gone at, but not to do it well himself, could not get into the good graces of an employer and get the opportunity of acquiring skill without going through a probationary period quite equal to an ordinary apprenticeship. In modern shop organization there is left no room for the learner except as it is provided for by a training school within the shop. If the shop is small this provision is so expensive as to be out of the question. A city like Worcester, having no great shops can only expect to have trade schools at the public expense. Once beginning, they must follow the line to its logical conclusion and carry the student to the point where he will be acceptable to an employer in a position where what he has learned at the public expense will enable him to work higher without unlearning in the large works what has been taught him in the trade school. Another matter: does the Worcester plan leave out that which might better be a part of the school curriculum? Does it plan to teach all that a young man who expects to be a machinist may reasonably be expected to know? To this last question I would say yes, and more. For the boy who has higher aspirations or who

FIG. 8. PORTAL OF TUNNEL IN GRANITE.

FIG. 9. THE OPEN CANAL DURING CONSTRUCTION.
[Excavation completed; track being laid for concreting.]

Fig. 10. Barrett Dam Site from Below, Jan. 25, 1907, Showing Winter Flow of Cottonwood Creek, San Diego Water Supply.

foundation block begun. Fig. 7 gives its dimensions. As will be seen it is an annular mass, with circular inner edge 47 ft. in diameter at the bottom and octagonal outer boundary 103 ft. across flats at the footing level, tapering to 10 ft., except in the octagonal base, and the greatest 50 ft., as shown by Fig. 6 and in the table of loads and stresses, below.

A heat protecting lining 4 ins. thick extends from bottom to top of the stack. It is of the

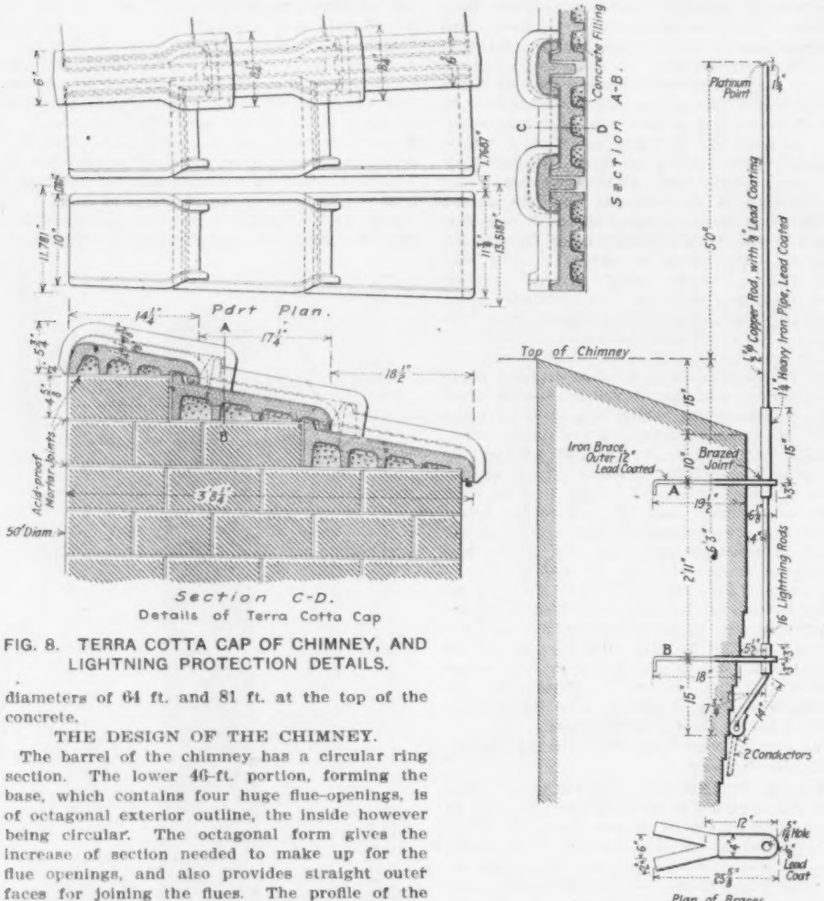


FIG. 8. TERRA COTTA CAP OF CHIMNEY, AND LIGHTNING PROTECTION DETAILS.

diameters of 64 ft. and 81 ft. at the top of the concrete.

THE DESIGN OF THE CHIMNEY.

The barrel of the chimney has a circular ring section. The lower 46-ft. portion, forming the base, which contains four huge flue-openings, is of octagonal exterior outline, the inside however being circular. The octagonal form gives the increase of section needed to make up for the flue openings, and also provides straight outer faces for joining the flues. The profile of the stack presents four separate tapers, as follows: the upper 180 ft. 1% batter (or a taper of 2% measured on the diameters); the 100 ft. next below, 2% batter (4% taper); the next 180 ft., 3½% batter (7% taper); and the octagonal base, 4% batter (8% taper). These tapers, in conjunction with increasing thickness of wall in steps of 2 ins., gave the required increase of strength from top to bottom in due proportion to maintain the maximum compression below a fixed limit.

The height of section having constant wall-thickness is of course variable, the lowest being now well-known sectional construction, in which the chimney wall is corbeled inward at intervals not exceeding about 20 ft. and the lining is sectionalized correspondingly, each section, resting on its corbel, being independent of the remainder of the lining. This lining increases the moment of stability against wind-pressure at every section (which would not be the case if it were supported only at the bottom), though, of course, it does not add to the effective cross-section in the matter of strength.

The determination of the wall-thicknesses proceeded by analysis of stresses from the top downward, exactly as in the case of a dam for example. The thickness at top (18 ins.) was fixed arbitrarily, except in so far as it was determined by the requirement of support for a future addition of 60 ft. At a section a given distance below the top, assuming the wall thickness constant, and the external profile being selected beforehand, the weight of brickwork above this level is computed, and the pressure per square foot due to this weight is then found by dividing by the area of section. The total wind pressure above the section and its overturning moment are next computed, and the moment divided by the section modulus of the cross-section under consideration gives the unit-stress due to wind. If this wind stress is less than the pressure from weight the maximum pressure (leeward edge) is obtained by adding the wind stress to the weight stress, and the minimum pressure (windward edge) by subtracting the wind stress from the weight stress. If the maximum pressure exceeds the limiting safe stress allowed in the brickwork, the thickness must be increased at a point above this section, the height of this point being such that the allowed limit of pressure is just reached at its windward edge. This point of change of section may be determined either by several trial computations, as by calculating stresses at short intervals from the top downward, say 5 ft. or 1 ft., depending upon the rapidity of increase of stress, or it may be determined by putting the stress calculation into algebraic form, with the height below the top as unknown quantity, and solving the resulting quadratic equation. In either case the details of the method will be self-evident, and the preceding explanation is given only to explain the table below, in which are entered the essential quantities of the calculation for each of the 23 sections of change of thickness in the barrel of the chimney, and for the footing level (section 24).

The limit of pressure in the brickwork was fixed beforehand at 21 tons per sq. ft. (290 lbs. per sq. in.) for the present height, and 22 tons per sq. ft. (305 lbs. per sq. in.) for the contemplated future increase of height by 60 ft. Bricks of the kind used here (hard-burned perforated brick for chimney work have previously given ultimate crushing strengths in laboratory tests (by Prof. I. A. Woolson) up to 6,000 lbs. per sq. in. gross section, or about 400 tons per sq. ft. As will be seen from the table, the actual stresses for the wall thicknesses shown in Fig. 6, exceed the limit of 21 tons by less than ½%. At the same time the stress on the windward side is never reduced to the point of incipient tension, and in fact the wind stress in the worst case is less than one-half the dead-load.

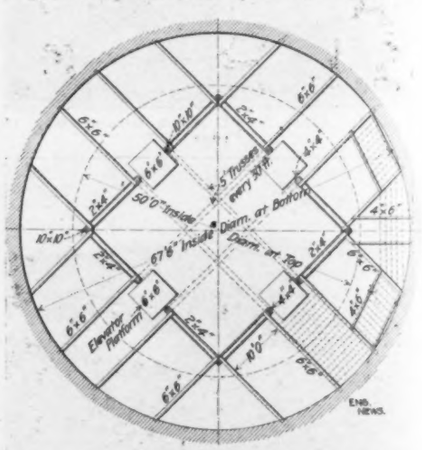


Fig. 9. Bricklayers' Scaffold in Interior of Chimney.

RESULTS OF CALCULATIONS FOR 506 FT. CHIMNEY AT GREAT FALLS, MONTANA.

Outside diameter: at base, 78 ft. 6 ins.; at top, 53 ft. 9 ins. (end of corbeled cap enlargement). Inside diameter (excl. lining and air space): at base, 66 ft. 6 ins.; at top, 50 ft. 9 ins. (50 inside terra-cotta cap).

Number of section.	Thickness of wall, ins.	Height of section, ft.	Total from top, ft.	Weight above section, tons.	Wind pressure above section, lbs.	Wind moment at section, ft. tons.	Cross-section area of brickwork, sq. ft.	Section modulus ft.³	Total bearing pressure—Leeward—tons/ft.²	Leeward—lbs./in.²	Windward—tons/ft.²	Windward—lbs./in.²
1	18½	50	50	725	90,450	1,127	252.66	3274.83	3.21	45	2.53	35
2	20½	50	100	1,693	182,575	4,536	284.72	3740.03	7.16	99	4.74	66
3	22	40	140	2,574	257,475	8,936	315.54	4183.48	10.30	143	6.02	84
4	24	40	180	3,499	333,435	14,843	347.90	4655.18	13.25	184	6.87	95
5	26	35	215	4,396	401,183	21,268	385.0	5256.74	15.49	215	7.39	103
6	28	35	250	5,356	470,565	28,893	424.26	5907.32	17.51	243	7.73	107
7	30	30	280	6,263	531,335	36,405	462.36	6541.10	19.11	266	7.99	111
8	32	30	310	7,259	593,735	44,840	500.08	7432.63	20.23	281	8.17	113
9	34	20	330	7,961	636,535	50,900	552.51	8213.94	20.61	286	8.21	114
10	36	20	350	8,711	680,248	57,567	596.31	9028.47	20.99	292	8.23	114
11	38	15	365	9,329	713,645	62,794	637.8	9776.42	21.04	292	8.20	114
12	40	15	380	9,966	747,567	68,273	681.39	10568.55	21.06	293	8.16	113
13	42	13	393	10,558	777,391	73,229	723.29	11328.48	21.05	292	8.13	113
14	44	13	406	11,175	807,609	78,380	765.96	12113.55	21.06	293	8.12	113
15	46	13	419	11,825	838,222	83,728	810.40	12938.26	21.06	293	8.12	113
16	48	11	430	12,410	864,433	88,410	852.88	13716.82	20.99	292	8.11	113
17	50	10	440	12,964	888,506	92,792	895.06	14485.40	20.89	290	8.07	112
18	52	10	450	13,539	912,813	97,296	938.82	15286.18	20.78	288	8.06	112
19	54	10	460	14,140	937,353	101,921	982.11	16090.52	20.83	289	8.17	113
20	60*	16	476	15,304	980,214	109,591	1065.87	17398.99	20.66	287	8.06	112
21	62*	15	491	16,312	1,021,057	117,095	1117.23	18480.58	20.94	291	8.26	115
22	64*	8	499	16,884	1,043,101	121,223	1158.30	19257.38	20.87	290	8.29	115
23	66*	7	506	17,404	1,062,539	124,908	1196.34	19962.12	20.81	289	8.29	115
Footing: 24	336*	22½	528½	24,964	0	136,862	7053.56	106173.0	4.83	67	2.25	31

*In octagonal part; thickness given is at flats.

DETAILS OF CONSTRUCTION.

BRICK WALL CONSTRUCTION.—The brick used for the main chimney wall is the vertically perforated radial style of brick widely

fore specified that provision was to be made for gales up to 125 mi. per hr., and in the course of the design this clause was translated into the following terms: Effective pressure against cylindrical (really conical) surfaces of barrel, 33⅓ lbs. per sq. ft. diametral projection; effective pressure against octagonal base portion, 35⅓ lbs. per sq. ft. diametral projection in plane of parallel sides.

The contract made with the chimney construction company was contingent on the possibility of producing satisfactory brick from the material found at the site. A strong and fairly uniform shale forms the body of the plateau, hard rock occurring only at a considerable depth, near the level of the valley bottom. This shale was thoroughly studied, chemically and by making test bricks of it, with the final conclusion that it was entirely suitable for the purpose. Thereupon a brickmaking plant was built on the ground, near the chimney site. Shale was excavated by steam-shovel from a pit not far away, and except for a small admixture of fire-clay brought in by railway from a point 12 mi. away, it formed the material for the entire stack. Selected portions of the shale made the special heat-resisting and acid-proof brick of the 4-in. inner lining.

As concerns a foundation, no hesitancy was felt in deciding that the shale would be quite sufficient for carrying the 17,000 to 18,000 tons weight of the stack. The first plans were for carrying an excavation down 30 ft. and building a concrete spread footing up from this level, with a maximum pressure (at lee edge, from load plus wind) not exceeding 5 tons per sq. ft. But as the excavation went on the shale showed up so uniform that no particular advantage was to be expected by going to 30 ft., and at 20 ft., therefore, a load test was made to determine whether the bearing power at that level was sufficient. Four cast-iron bed-plates, each 2 ft. square, were loaded with rails to the total amount of 208,935 lbs., which load was left on for about a month. The slight initial depression under this load did not increase throughout the test period, from which it was concluded that the load was well within the limit of stability. This loading amounted to 6½ tons per sq. ft., whereas the maximum pressure at lee edge, if the foundation were terminated at about this level, would be slightly below 5 tons per sq. ft.

The excavation was therefore terminated at 22½ ft. below ground surface, and the concrete

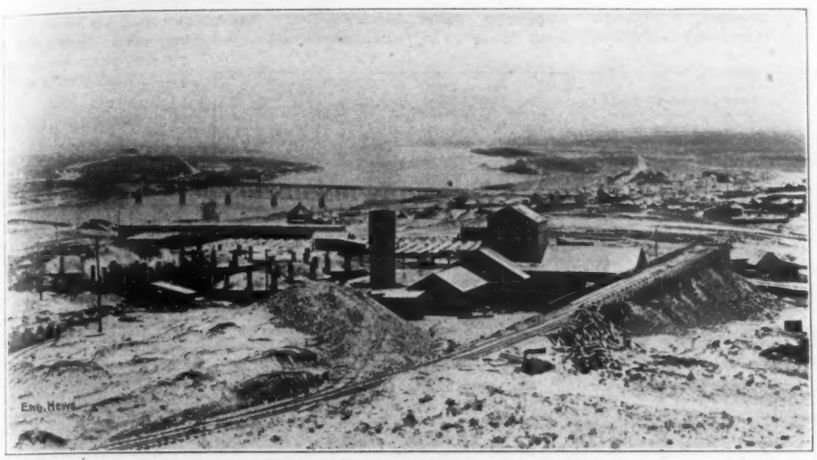


FIG. 5. THE BRICK-MAKING PLANT.

(This plant was built specially for supplying the hard-burned radial perforated blocks of which the chimney is built. It is only a few hundred feet from the site of the stack, and uses shale excavated near-by. It comprises a steam drying kiln, a large air drying kiln, and eight down-draft burning kilns.

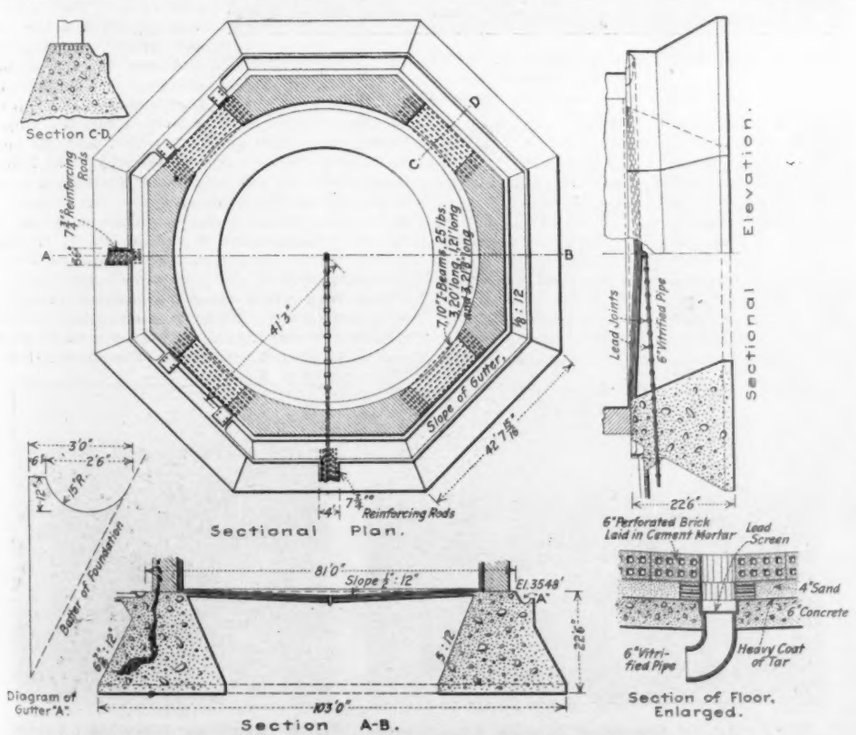


FIG. 7. DETAILS OF CONCRETE FOUNDATION, GREAT FALLS CHIMNEY.

(The pavement, resting on the earth core inside the foundation ring, is made of acid-proof brick.)

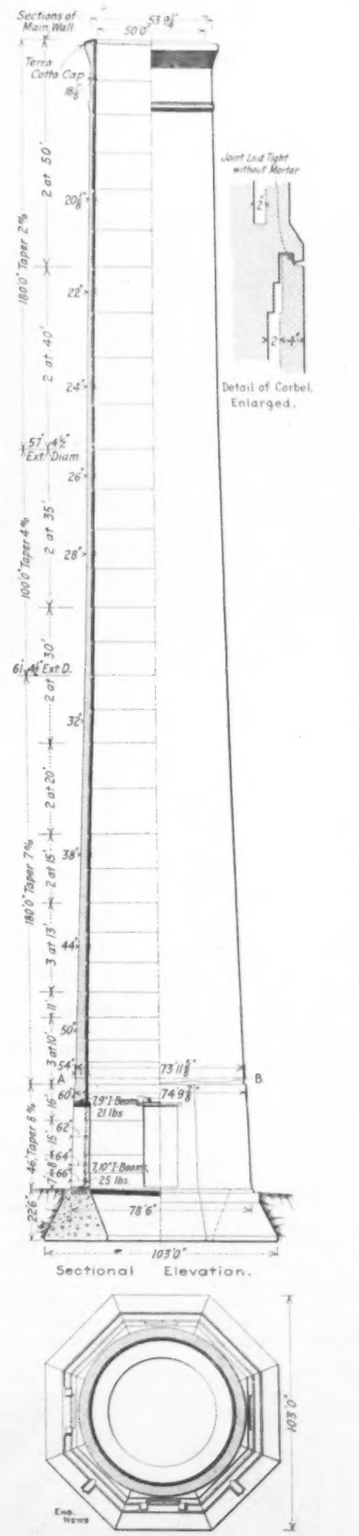


Fig. 6. General Drawing of 50-Ft. x 506-Ft. Chimney for Boston & Montana Consolidated Copper & Silver Mining Co., at Great Falls, Mont.

To distribute the load of the piers either side of the openings to the entire foundation, steel sills have been put under the openings. They comprise at each opening seven 10-in. 20-lb. I-beams 21 ft. long, embedded 12 ins. below the top of concrete.

The sides of the flue openings are protected by an extension of the lining.

ERECTION.

FOUNDATION.—The foundation was built by the owners themselves, with the supervision of an engineer of the contractor for the chimney. It consists of 1:3:5 slag concrete. Both sand and stone were obtained from the smelter furnaces. They were brought to a group of temporary bins by the side of the foundation pit, and a mixer mounted directly under the bins discharged the concrete through a chute down to the work, or into skips. A derrick with 50-ft. boom was set in the center of the foundation, on the unexcavated core, and handled the concrete from the mixer to all parts of the circle.

The foundation consumed 5,200 bbls. cement, 2,000 cu. yds. sand and 4,000 cu. yds. smelter slag. Its total cost was not far from $50,000. It was constructed during 1907, the contract for the entire stack having been signed late in 1906.

BRICKMAKING PLANT.—During 1907 also the chimney contractor was engaged in putting up a brickmaking plant on the ground and producing bricks in preparation for erection. Some 23,000 tons of brick were required. A plant of capacity of 100 tons per day was installed (see Fig. 5). The company describes it as follows:

> The plant was installed to operate with the semi-wet or stiff clay process involving a drying pan crusher, a pug mill, both steam and hot air dryers and nine down-draft kilns. The shale is excavated from the pit at the rear of the plant, by a steam shovel with a 1-yd. dipper and delivered to the latter by dump cars on a narrow gage track which dumps from a trestle on to a pile at the rear of the crusher house. The material is then shoveled to a Freese dry-pan crusher from which it is elevated by a bucket conveyor to a storage bin above the pug mill in the machine room. The pug mill is also a Freese mill in which sufficient water is added to the material for the formation of a stiff clay mixture and from which it is forced through forming dies for shaping the blocks, to the wire cutters. From the latter the green blocks are removed on a conveyor belt and thence transferred by hand to four-wheel steel-frame trucks running on narrow-gage tracks. They are first run into the steam drier in which the special treatment is given to counteract the alkali in the material and thence after partial drying, they are transferred to the hot-air drier for final drying before burning. This mode of treatment was found necessary to prevent checking of the blocks which would otherwise have injured their quality. The kilns are circular domed-roof kilns of the down-draft type and are fired with Montana coal.

The bricks were carried from brick-plant to chimney site by a standard-gage railway spur half a mile long, including a switchback to overcome the considerable difference of elevation. They were piled around the base of the chimney ready to be hoisted up to the work as required.

The erection scaffolding, carried up inside the chimney as the brickwork rose, is shown in plan by Fig. 9. Twelve main posts, 10 × 10-in., braced together and to the brickwork, support working platforms and contain guides for four 6 × 6-ft. elevators. The main posts were made in 16-ft. lengths, doweled together and spliced with cover straps of 2 × 10 plank bolted through. Over 200 M-ft. lumber were used in the scaffolding. Three electrically operated drum hoists and one steam-driven hoist worked the elevators.

The progress of the masonry is exhibited typically by Figs. 10-12, three views of the stack in different stages. The dates of commencement and completion, April 7 and Oct. 23, 1908, show that the whole work was done in a period of 200 days, or 169 working days, making an average of practically 3 ft. of height laid per day. This does not include the lining, which is being put in at present, being started at three or four levels simultaneously.

The stack above foundation required 13,000 tons radial blocks, 3,075 bbls. cement, 5,225 bbls. lime, 4,180 cu. yds. sand and 200 tons acid-proof mortar. It cost about $200,000; in this sum, however, the entire first cost of the brickmaking plant is included, which plant will be left there and operated to supply material for the great dust-chamber and flue and for other construction work around the smelter plant.

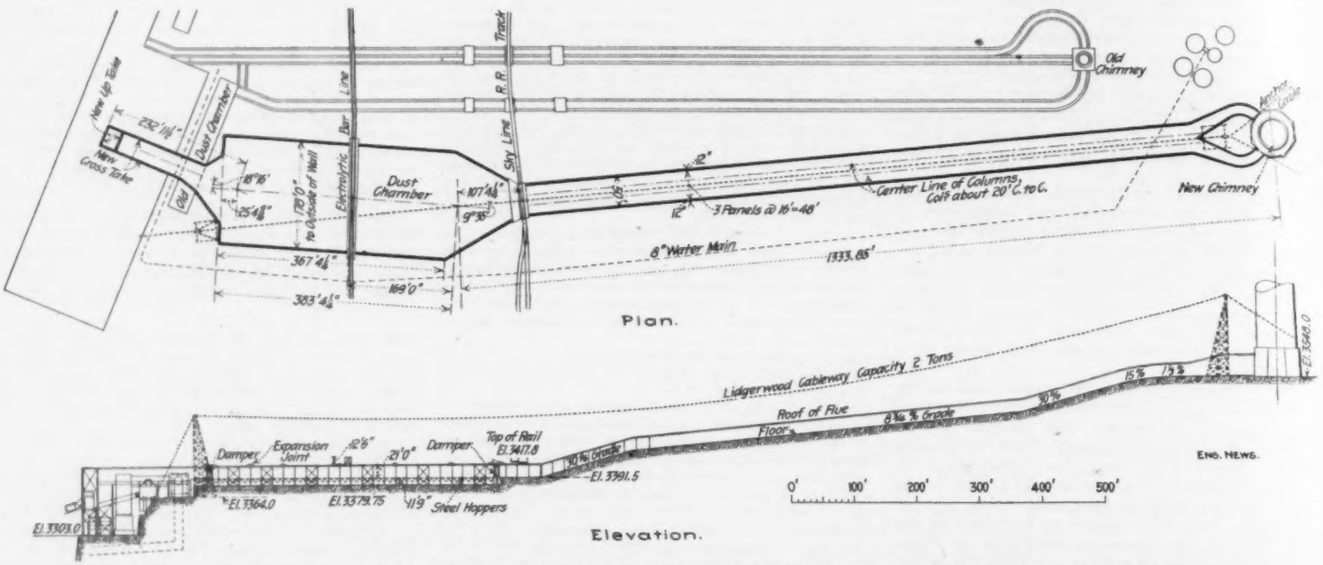


FIG. 14. LOCATION PLAN AND PROFILE OF FLUE AND DUST-SETTLING CHAMBER BETWEEN SMELTER AND CHIMNEY.

DUST-CHAMBER AND FLUE.

The flue gases carry considerable quantities of metalliferous dust, which is valuable and must be collected for recovery. A dust settling chamber is provided in the flue for this purpose. The chamber of the old flues, as also these flues themselves, had been far outgrown by the extension of the smelter. The new chimney will be fed by a new flue, and in this is a dust-chamber many times greater than the old one, as an inspection of Fig. 14 demonstrates. This chamber is a widened part of the flue in which is hung a close array of iron straps to catch the dust in the gases. It is fitted with a continuous series of floor-hoppers, beneath which is a basement with tracks, in which cars are to be run along underneath the hoppers so that the accumulated dust may be discharged directly into the cars. The dust chamber is 176 ft. wide by 478 ft. long, with a clear height of 21 ft. (the same as the height of the flue). The basement story is 12 ft. high.

The flue has rectangular cross-section, 33 × 21 ft. in the part between smelter and chamber, and 48 × 21 ft. between chamber and stack. Near the stack it divides into two branches which curve around and join the flue-openings at the base of the stack. Its profile is fully shown in Fig. 14.

Both flue and chamber are framed in steel, with steel columns (interior and wall) and cross-beams, and walls and roof of perforated brick. In the walls the flanges of the columns are exposed both inside and outside. The roof beams are also exposed on the inside, but on the outside they are protected by a thick covering of concrete laid over the brick arches. The purpose of this covering is to make the roof weather-proof, so that no moisture can get into the flue. The dry gases are not corrosive to the metal.

The steel frame has transverse expansion joints about every 90 ft., formed by a bulged plate covering an expansion space between the frame pieces of adjoining sections. The outer surface of these expansion membranes is left exposed. Expansion is provided for in the walls by a grooved joint in the brickwork.

The flue and dust-chamber were designed by the Boston & Montana Consolidated Copper & Silver Mining Co. The steel was built by the Jones & Laughlin Steel Co., of Pittsburg, and the brickwork is to be built by the Alphons Custodis Chimney Construction Co., of New York.

AN ELECTRIC FERRY BOAT on the Rhine is described with illustrations in the London "Electrical Engineering," Oct.' 8. This boat provides regular service between Godesberg and Niederdollendorf and is licensed to carry 645 persons. There is free space on a wooden fore-deck to accommodate four harnessed vehicles. The hull is of steel with these compartments between bow and stern: collision space, cabin with bunks for crew, battery room and machine and store room. The bow and low fore decks occupy about two-thirds of the upperworks and on the rear third is the deck house. The back part of this is fitted as a saloon and the front as a navigating cabin. From this latter division which is higher than the saloon and somewhat like a pilot house a free outlook is obtained in all directions. The helm, the motor controls and the electricity-measuring instruments are, of course, in the navigating cabin.

The boat is propelled by two screws each driven by an open frame, interpole, 300-volt, 50-HP. motor at 300 r. p. m. The screws may be controlled separately or together. The battery, located below deck, consists of 160 storage cells in vulcanite cases and has a capacity of 335 amp.-hrs. on a 1-hr. discharge rate, the pressure being about 290 to 300 volts. The battery room is ventilated by portholes and outlet pipes. Two 3-HP. motors operate landing gangways. The batteries are charged on the Godesburg side of the river through a flexible cable which is carried aboard to a plug contact. The landing stage consists of a pontoon, 52 ft. 6 ins. by 16 ft. 5 ins., connecting to the shore by a bridge 82 ft. long. The boat evidently makes fast along side the pontoon and vehicles drive across the decks.

Fig. 12. About 240 Ft. Above Ground, July 23, 1908.

Fig. 11. About 50 Ft. Above Ground, May 14, 1903.

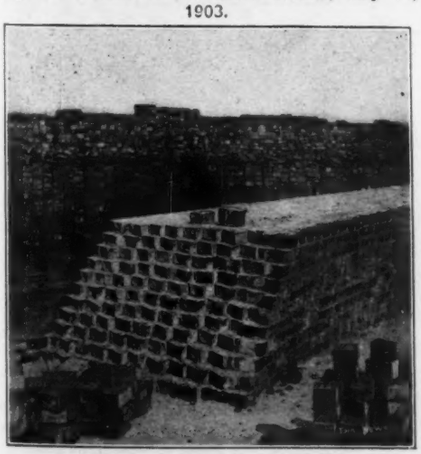


Fig. 10. The Octagonal Base Started, April 10, 1908.

Figs. 10-12. Three Views During the Construction of the 506-Ft. Chimney, Boston & Montana Consolidated Copper & Silver Mining Co., at Great Falls, Mont.

used for chimney construction. (See Eng. News, Nov. 21, 1901, p. 398.) Five sizes were used, all being 4⅝ ins. thick and 6¼ to 6$^{11}/_{32}$ ins. wide at butt, with the following lengths: 4 ins., 5 ins., 7⅛ ins., 8⅝ ins., and 10⅝ ins., which permit thorough bonding in radial direction.

The mortar was 1:2:5 cement-lime-sand mortar. For a distance of 50 ft. below the top, the outer surfaces of the brickwork were pointed up with acid-proof mortar.

At the junction of the octagonal base with the circular barrel, the horizontal ledge of the brickwork of the base is capped with a steeply sloped filling of concrete, as rain protection. This is the more necessary as the large quantities of rain water which may drain down along the outer surface of the chimney must be turned here, without the possibility of water percolating down into the brickwork of the base.

LINING.—The lining is simply a 4-in wall of acid-proof brick, with vertical perforations like the brick of the chimney body, resting on corbel rings on the inner face of the chimney wall as already described, and laid up so as to leave a 2-in. air-space between wall and lining. It is laid in "acid-proof mortar," a white composition of silicate of soda, asbestos wool and other ingredients, which is said to be proof against the attack of any acid and against temperatures of 2,000° F. The heights of the sections of lining are kept down to 20 ft. A new section of lining is started at the base of each section of chimney wall, and where the latter is more than 20 ft. high an intermediate corbel is also provided, making two (in some cases three) lining sections for the one wall section.

The joint between the top of one lining section and the bottom of the next is detailed as shown by sketch in Fig. 6, the entire interior face being acid-proof brick. The aim was to get as nearly tight a joint as possible, to prevent access of gases, dust, etc., behind the lining. To this end, also, a packing of mineral wool was put the into the space at the top of the lining.

There are no vent-holes through the outside wall to the air-space.

CAP AND OTHER TOP PROTECTION.—The top of the chimney is corbeled out, in steps of ¾-in., to a thickness of 42 ins., from the 18-in. wall thickness of the top section. The upper surface is sloped down from the inner edge to outer edge 4 ins. to the foot. It is covered with specially shaped radial interlocking terra-cotta tiles laid solid in acid-proof cement and pointed up with the same material (see Fig. 8). These have separate T-shaped joint-capping tile. The upper 3 ft. part of the brickwork of the chimney wall is also laid in acid-proof mortar.

LIGHTNING PROTECTION.—Sixteen lightning-rods project 5 ft. above the chimney top. They are of 1-in. round copper rod, lead coated for protection against acid and tipped with a platinum point 1¼ ins. high. They are all connected to a horizontal copper ring encircling the stack a few feet below the top, and from this ring two ⅝-in. copper cables lead to the ground. All of this metal-work, down to a point 100 ft. below the top, is coated with an ⅛-in. thickness of lead for protection against acid, and where two pieces cross or connect their coatings are sweated together to make a continuous covering. The bottom ends of the two leader cables terminate at copper ground-plates 3 ft. square, buried some distance away from the chimney foundation.

LADDER.—An outside ladder extending from the base to cap was built in the brickwork. It consists of one-piece rungs of ¾-in. round iron, 12 ins. wire, and one-piece guard loops of the same material, 30 ins. wide. The rungs are 6 ins. clear from the wall, and the guard loops are 18 ins. out from the rungs. Guard loops are at alternate rungs. Both guards and rungs are lead-coated for the upper 100 ft., and painted below this.

DRAINAGE.—To take care of the drainage from the outer surface of the stack required special attention in this chimney because of its enormous exposed surface, and the large volume of water which might run off from it in a heavy driving rain. Rainfall and condensation inside the chimney also required suitable provision.

The outer drainage was provided for by a large gutter molded in the top of the concrete foundation, extending all the way around the stack and discharging by two concrete spouts. This gutter is semicircular, 30 ins. wide by 12 ins. deep near the gutter, sloping down toward this point ¼-in. per ft. The photograph Fig. 4 and the drawing Fig. 6 show it completely.

Inside an acid-proof pavement pitched to a drain-pipe was provided. The pavement comprises a 6-in. concrete foundation, 4 ins. of sand, and a layer of acid-proof brick laid in acid-proof mortar. It is pitched ½-in. per ft. toward the center, where the bricks are laid to form an 8-in. drainage opening leading to a 6-in. vitrified tile duct. The opening in the floor is covered with a lead screen.

REINFORCEMENT OF FLUE OPENINGS.—The octagonal base contains four openings 15 ft.

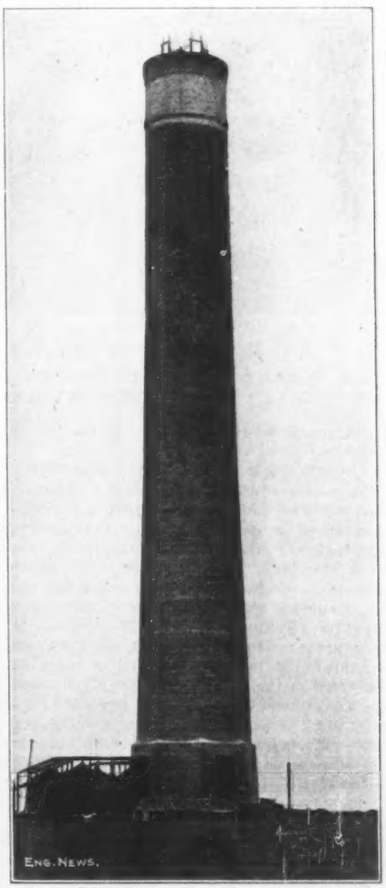


Fig. 13. The Completed Chimney.
(The white appearance of the upper 50 ft. is due to the pointing with special acid-proof mortar.)

wide by 36 ft. high for connecting the flues leading from the smelter plant. An I-beam lintel carries the brickwork over each of these; it consists of seven 9-in. 21-lb. I-beams 19 ft. long, resting at either end on a 24 × 1-in. steel bearing plate 7 ft. long. Specially shaped bricks set in acid-proof mortar enclose the lower flanges of the beams as protection from the heat and the corrosive action of the flue gases.

Arches in such a location as the top of the flue opening do not prove satisfactory, in the experience of designers of this chimney, at least when over 6 to 8 ft. in span. Even though they are only false or fascia arches, cracking outward from the skew-back is bound to develop sooner or later.

For the first, only two of the flue openings are to be used (see plan of flue, Fig. 14), and the idle openings are bricked up with 15-in. walls containing 2 × 3-ft. cleanout doors through which the metalliferous dust accumulating in the stack may be removed.

THE CONVENTION OF THE INTERNATIONAL ELECTRO TECHNICAL COMMISSION AND THE RECENT INTERNATIONAL CONFERENCE UPON ELECTRICAL UNITS AND STANDARDS.

ELECTROTECHNICAL COMMISSION. — The International Electrotechnical Commission which met in London, England, during the week of Oct. 19, had its inception due to a paper on standardization read by Col. R. E. B. Crompton before a meeting of the government delegates to the International Electrical Congress at St. Louis in 1904. At that meeting it was resolved that steps should be taken to secure the cooperation of the technical societies of the world for the appointment of a representative commission to consider the standardization of electrical machinery and apparatus. A preliminary meeting was held in London in June, 1906, when Lord Kelvin was elected President and Col. Crompton as Honorary Secretary. Rules for standardization were provisionally adopted and the secretary was authorized to continue a further organization of the movement.

The first business of the recent meeting was to elect a new president. Prof. Elihu Thomson, of Lynn, Mass., U. S. A., was elected by acclamation. Col. Crompton was re-elected Honorary Secretary.

In the report of the Honorary Secretary it was stated that the council of the Institution of Electrical Engineers had given $1,000 and had loaned $1,000 to assist in the formation of the central office of the commission. It was also reported that there were ten electrotechnical committees organized in good working shape in as many countries. Six more were about to be started and still another six were under consideration.

The ratification of the 1906 rules came up for debate but the records do not show that decisive action was taken. The location of the central office of the Commission and the change of the name of local committees, serving for the various countries, to electrotechnical committees were adpoted without discussion. The French delegation proposed a radical modification of the way in which the recommendations of the Commission should be promulgated. After much debate a compromise measure was accepted and is expressed in the following rule:

Each country shall be entitled to one vote only, either by person, by proxy or by correspondence, whatever number of delegates it may appoint. Only such decisions may be published as those of the International Electrotechnical Commission which have been passed by a majority of at least four-fifths of the votes registered.

There were several proposals as to the system on which the rules and nomenclature should be drawn up for publication. The German delegates proposed a cooperative scheme with the publishers of a technical dictionary. Such a move, however, was not approved as it was the general sentiment that the function of the Commission was not to prepare a complete dictionary but rather to define and explain certain terms for international use. The following basis for the intercommunication of work was adopted:

Each Electrotechnical Committee should forthwith commence its work in nomenclature by preparing an electrotechnical glossary, arranged in alphabetical order, in its own language. These terms, together with their explanations translated into the official languages of the Commission (English and French), shall, as soon as the list for the first five letters (A—E) is completed, be forwarded to the central office for communication to the other Electrotechnical Committees. The same procedure shall be followed for the next five letters, and so on until the alphabet is completed. In carrying out this work each Electrotechnical Committee should, as far as practicable, utilize the work already done by others, to whom due credit should be given in each case.

The subjects of a provisional standard of light and the metric system were discussed. The first subject was passed over to enable the committees to become more fully informed and to attempt to harmonize the interests of gas and electric industries in such a work. It was agreed that such figures as were necessary in the recommendations of the Commission should be expressed in the metric system. It was conceded, however, that for countries which did not generally employ the metric system, there should be the right to express the equivalent value in brackets.

CONFERENCE ON UNITS AND STANDARDS.—The International Conference Upon Electrical Units, which was called together by the British Government, held several sessions in London during the two weeks following Oct. 12. The main object of this conference is to obtain international agreement on the three fundamental electrical units, the volt, the ohm and the ampere.

Lord Rayleigh acted as President of the conference.

The conference adopted the following resolutions and specifications, officially known as "Schedule B," and requested the delegates to lay them before their respective governments for adoption:

1. The Conference agrees that as heretofore the magnitudes of the fundamental electric units shall be determined on the electromagnetic system of measurement with reference to the centimeter as the unit of length, the gramme as the unit of mass, and the second as the unit of time. These fundamental units are (1) the ohm, the unit of electric resistance which has the value of 1,000,000,000 in terms of the centimeter and second; (2) the ampere, the unit of electric current which has the value of one-tenth (0.1) in terms of the centimeter, gramme, and second; (3) the volt, the unit of electromotive force which has the value 100,000,000 in terms of the centimeter, the gramme, and the second; (4) the watt, the unit of power which has the value 10,000,000 in terms of the centimeter, the gramme and the second.

2. As a system of units representing the above and sufficiently near to them to be adopted for the purpose of electrical measurements and as a basis for legislation, the Conference recommends the adoption of the international ohm, the international ampere, and the international volt defined according to the following definitions.

3. The ohm is the first primary unit.

4. The international ohm is defined as the resistance of a specified column of mercury.

5. The international ohm is the resistance offered to an unvarying electric current by a column of mercury at the temperature of melting ice, 14.4521 grammes in mass, of a constant cross sectional area, and of a length of 106.300 centimeters. To determine the resistance of a column of mercury in terms of the international ohm, the procedure to be followed shall be that set out in Specification 1, attached to these resolutions.

6. The ampere is the second primary unit.

7. The international ampere is the unvarying electric current which, when passed through a solution of nitrate of silver in water, in accordance with the Specification II. attached to these resolutions, deposits silver at the rate of 0.00111800 of a gramme per second.

8. The international volt is the electrical pressure which, when steadily applied to a conductor whose resistance is one international ohm, will produce a current of one international ampere.

9. The international watt is the energy expended per second by an unvarying electric current of one international ampere under an electric pressure of one international volt.

Specification I.—(Specification Relating to Mercury Standards of Resistance)—The glass tubes used for mercury standards of resistance must be made of a glass such that the dimensions may remain as constant as possible. The tubes must be well annealed and straight. The bore must be as nearly as possible uniform and circular, and the area of cross-section of the bore must be approximately one square millimeter. The mercury must have a resistance of approximately one ohm. Each of the tubes must be accurately calibrated. The correction to be applied to allow for the area of the cross-section of the bore not being exactly the same at all parts of the tube must not exceed five parts in 10,000. The mercury filling the tube must be considered as bounded by plane surfaces placed in contact with the ends of the tube. The length of the axis of the tube, the mass of mercury the tube contains, and the electrical resistance of the mercury are to be determined at a temperature as near to 0° C. as possible. The measurements are to be corrected to 0° C. For the purpose of the electrical measurements, end vessels carrying connections for the current and potential terminals are to be fitted on to the tube. These end vessels are to be spherical in shape (of a diameter of approximately four centimeters) and should have cylindrical pieces attached to make connections with the tubes. The outside edge of each end of the tube is to be coincident with the inner surface of the corresponding spherical end vessel. The leads which make contact with the mercury are to be of thin platinum wire fused into glass. The point of entry of the current lead and the end of the tube are to be at opposite ends of a diameter of the bulb; the potential lead is to be midway between these two points. All the leads must be so thin that no error in the resistance is introduced through conduction of heat to the mercury. The filling of the tube with mercury for the purpose of the resistance measurements must be carried out under the same conditions as the filling for the determination of the mass. The resistance which has to be added to the resistance of the tube to allow for the effect of the end vessels is to be calculated by the formula.

$$A = \frac{0.80}{1,003\pi}\left(\frac{1}{r_1}+\frac{1}{r_2}\right)\text{ohm},$$

where r_1 and r_2 are the radii in millimeters of the end sections of the bore of the tube. The mean of the calculated resistances of at least five tubes shall be taken to determine the value of the unit of resistance. For the purpose of the comparison of resistance with a mercury tube the measurements shall be made with at least three separate fillings of the tube.

Specification II.—(Specification Relating to the Deposition of Silver).—The electrolyte shall consist of a solution of from 15 to 20 parts by weight of silver nitrate in 100 parts of distilled water. The solution must only be used once, and only for so long that not more than 30% of the silver in the solution is deposited. The anode shall be of silver, and the cathode of platinum. The current density at the anode shall not exceed 1/5 ampere per sq. cm. and at the cathode 1/50 ampere per sq. cm. Not less than 100 cu. cm. of electrolyte shall be used in a voltameter. Care must be taken that no particles which may become mechanically detached from the anode shall reach the cathode. Before weighing, any traces of solution adhering to the cathode must be removed, and the cathode dried.

The Conference recommended the use of the Weston cell, as a convenient method of measuring E.M.F. for voltage and current determinations, when set up in accordance with the following specification officially known as Schedule C.

The Weston normal cell may be conveniently employed as a standard of electric pressure for the measurement both of E.M.F. and of current, and when set up in accordance with the following specification, may be taken, provisionally, as having, at a temperature of 20° C., an E.M.F. of 1.0184 volts.

Specification Relating to the Weston Normal Cell.—The Weston normal cell is a voltaic cell which has a saturated, aqueous solution of cadmium sulphate ($CdSO_4 8/3 H_2O$) as its electrolyte. The electrolyte must be neutral to Congo red. The positive electrode of the cell is mercury. The negative electrode of the cell is cadmium amalgam consisting of 12.5 parts by weight of cadmium in 100 parts of amalgam. The depolariser, which is placed in contact with the positive electrode, is a paste made by mixing mercurous sulphate with powdered crystals of cadmium sulphate and a saturated aqueous solution of cadmium sulphate. The different methods of preparing the mercurous sulphate paste will be described in notes. One of the methods there specified must be carried out. For setting up the cell, the *H* form is the most suitable. The leads passing through glass to the electrodes must be of platinum wire, which must not be allowed to come into contact with the electrolyte. The amalgam is placed in one limb, the mercury in the other. The depolariser is placed above the mercury and a layer of cadmium sulphate crystals is introduced into each limb. The entire cell is filled with a saturated solution of cadmium sulphate and then hermetically sealed. The following formula is recommended for the E.M.F. of the cell in terms of the temperature between the limits 0° C. and 40° C.

$$E_t = E_{20} - 0.0000406\ (t-20^\circ) - 0.00000095\ (t-20^\circ)^2 + 0.00000001\ (t-20)^3$$

The Conference recommended that the various governments interested should establish a permanent International Commission for Electrical Standards. A Committee of 15 was appointed to serve as advisors on the organization of a permanent commission, and, pending such organization, to formulate plans for such work as may be necessary in maintaining and comparing standards, fixing values and completing the work of this Conference. It was recommended that laboratories properly equipped for precise work should be asked to cooperate with this committee. The committee was also directed to consider the question of enlarging the International Conference of Weights and Measures to include the Conference of Electrical Units and Standards.

We are indebted, in preparing this brief summary of the work of these two international bodies, to the much longer accounts in (London) "Electrical Engineering" of Oct. 15 and 29 and "Electrician" of Oct. 23 and 30.

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The State of Illinois having voted $20,000,000 for the construction of a deep waterway from the drainage canal terminus down the Illinois River, the question arises under what direction the work should be done. We pointed out, in our issue of Nov. 5, the great advantage of having the public officials in charge of work requiring expert knowledge appointed rather than elected to office. In Illinois, however, agitation is on foot to have the Legislature make the canal board, which must be created to have charge of the canal work, an elective body. It can readily be seen that if this movement is successful, the positions on the canal board will be subject to the vicissitudes of partisan politics, and the party boss on each side will be the real arbiter in controlling the expenditure of the people's money. If Illinois desires to see its $20,000,000 honestly and efficiently expended, it will leave the appointment of the canal board in the hands of the Governor, subject if desired to confirmation by one or both branches of the State Legislature.

The annual convention of the Atlantic Deep Waterway Association, which has for its object the construction by the Government of a line of inland waterway channels parallel with the Atlantic coast, was held at Baltimore last week. The report of the Committee on Resolutions, adopted at the close of the convention, contains the following recommendations:

The purchase of the present Chesapeake & Delaware Canal and the construction of a new one.
Deepening the Hudson River to the point where it connects by canal with the lakes.
Selecting a route through Massachusetts from Narragansett Bay to Boston.
Deepening the present waterways from the North Carolina sounds to Norfolk.
Surveying New Jersey and New York along the Florida coast preliminary to further development.

Regarding these various schemes, the Chesapeake & Delaware Canal enterprise has almost certainly merit enough to justify favorable action by the Government, and the same may be said concerning the improvement of the Hudson River. Concerning the third project recommended, however, it is certainly open to question, whether an inland waterway route to cut off the detour around Cape Cod should start on the south from Narragansett Bay or Buzzards Bay. As many of our readers will remember, these two routes are being promoted by two rival corporations: the one from Narragansett Bay by the New York, Brockton & Boston Canal and Transportation Co., incorporated in 1906, and the route from Buzzards Bay by the Cape Cod Canal Co., which last year secured the backing of the banking firm of August Belmont & Co. and is expected to proceed with active work on construction whenever bonds on the enterprise can be sold.

The difficulty with either of these schemes, if carried out as a private enterprise and with reliance upon income from tolls on the traffic to pay a return to the investors, is that vessels would not be obliged to use them except in stormy weather. It must be remembered that both these canals would be put out of service by ice during the winter months, when navigation around Cape Cod is most hazardous. During the rest of the year, most vessels would make the journey around Cape Cod in fair weather, which prevails for probably three-fourths of the time, rather than pay any considerable tolls to pass through a canal. If, however, the Government were to build the waterway and open it to all traffic free of tolls, it would undoubtedly serve a much larger volume of commerce.

As to the comparative merits of the two routes for Government construction, all the present information points to the route from Buzzards Bay as being the most advantageous. The cost is roughly estimated at not more than one-third that of the canal from Fall River to Boston, and when rights-of-way and land damages were included for the latter project, it is probable that the disparity would be even greater.

A very pertinent suggestion regarding the sanitary control of watersheds was made at the last meeting of the New England Water Works Association by Mr. E. E. Lochridge. It is well known that the drought of the past summer and fall has lowered the storage reservoirs of water-supply systems throughout the East to a very low point. Recent rains have served to prevent total exhaustion in many cases, but have not filled the reservoirs, and in many cases the surface run-off is being taken almost directly into the supply mains. Under these conditions, any chance pollution is far more apt to cause harm than if it were distributed in a reservoir, where it would be disseminated in a large body of water and the normal processes of oxidation, etc., could take place. It is therefore particularly necessary that vigilance should be used in the sanitary policing of watersheds at this season.

A further feature concerning this matter is that, while large storage is undoubtedly a great safeguard against the spread of disease from a polluted water-supply, it fails to become effective at times like the present. It cannot therefore be claimed, as is sometimes done, that storage reservoirs can wholly take the place of other purification systems as a protection to the health of a community.

In another part of this issue we have reprinted extracts from an interesting paper by Mr. Sherard Cowper-Cowles, whose name has become familiar in connection with certain metallurgical developments such as the "dry-galvanizing" process using zinc dust in a heated chamber instead of a bath of molten metal and the process for electroplating copper upon a mandrel in such a way that its crystallization can be controlled and so that the copper may be immediately stripped from a mandrel as a wire, sheet or cylinder.*

The paper by Mr. Cowper-Cowles describes a process for producing iron tubes and sheets from ore or scrap by a single process. The method consists essentially in the electrolytic disposition of iron from such a solution and at such current densities as will give a dense, smooth and strong deposit in the form of a sheet or tube which requires no further metallurgical treatment. The solution is made by leaching from scrap or ore, and the inventor even suggests the possibility of underground leaching as a substitute for mining ore.

After considering all that the inventor has seen fit to disclose in his paper, it will doubtless be felt by many that his process can never become practical on a commercial scale. It is difficult, however, to set limits to the possibilities of electro-chemical processes when we consider what revolutions have been wrought in many industries already through electro-chemistry. It would seem that the new process might be immediately applied in the manufacture of special electrical and chemical apparatus where proper composition and strength have been attained only at high cost.

It is interesting to note, in Mr. Cowper-Cowles' paper, the part played by hydrogen in determining the physical characteristics of the iron articles produced. It seems analogous to the influence of carbon as introduced in the prevalent common metallurgical processes.

*Engineering News, April 11, 1907.

As noted in our last week's issue, the promoters of the Tunis monorail transportation system have obtained a franchise permitting them to install a short line in the outskirts of New York City, extending from Bartow Station, on the New York, New Haven & Hartford R. R., to Belden Point, City Island, a distance of about three miles. The line will replace a dilapidated horse-car line and can hardly fail to be an improvement over that system of transportation.

The Tunis system is very similar to the old Boynton system, which was extensively exploited by E. Moody Boynton, of Newburyport, Mass., nearly 20 years ago. The cars are balanced over a single rail and are kept from tipping over by a light overhead structure supported by posts at intervals. There is no reason why the system should not operate with good satisfaction from a mechanical point of view. There is nothing experimental in the use of the monorail; in fact, its use with suspended loads, in the telpherage system, in traveling cranes, etc., is very large, and there is besides that the well-known Elberfeld-Barmen passenger railway in Germany, in operation now for nearly ten years, where the cars are suspended from an overhead structure and a single rail is used.

The really important question regarding the Tunis system is whether it possesses any actual advantages over an ordinary two-rail road, and no satisfactory proof of this has ever been given. The usual claim for the monorail system is the possibility of attaining higher speeds; but, as a matter of practical engineering, the ordinary two-rail railway is capable of as high speeds as the public is willing to pay for. Furthermore, in any railway for city passenger traffic, the speed limit is fixed not by the roadway but by the possibility of keeping the line clear.

It has been claimed that the single-rail system is safer than the two-rail system. This was the argument especially used by the English inventor Behr, the promoter of the proposed single-rail high-speed line between Manchester and Liverpool. Mr. Behr had a working exhibit of his system in New York City two years ago, and made strong efforts to secure the construction of a line to Coney Island, but without ultimate success.

In the Tunis system, even if there were some slight advantage as respects liability to derailment (which would be hard to prove), there would still remain the liability to danger from any failure of the overhead structure. It may be taken as almost an axiom in engineering that a railway train is safer when on track laid on a solid roadbed than when it is on a bridge or other structure where safety is dependent upon the condition of an artificial erection, which must be properly built and properly maintained.

It has been argued for the single-rail system that it involves the placing of only one rail in the street pavement instead of two. This would be in some locations an important advantage, but it seems to be more than offset by the obstruc-

tion presented by the posts carrying the overhead structure.

There is a possibility that something advantageous may be worked out in monorail construction in connection with an elevated railway system, where the elevated structure could carry at once trains running on ordinary tracks for express traffic, and trains or cars suspended from the structure and running on a single rail, as in the Elberfeld-Barmen system. No line of this sort has ever been built, but its feasibility has been given careful consideration for the streets of Berlin.

The inefficiency of municipal administration in Chicago is dealt with severely by Mayor Busse of that city in an interview recently published. The city now has its own stations for generating electricity for the electric street lighting system, but a report made by Mr. Bion J. Arnold shows that a large saving may be effected by purchasing current generated at the power plant of the Chicago Drainage Canal. A somewhat smaller (but still important) saving could be made by purchasing current from the electrical companies.

The principal reason for the higher cost of the city's operation appears to be the great waste of material and time on the part of its employees.

We quote the following remarks from the interview mentioned above:

> A city employee seems to think that he is required to do only about one-fifth of a day's work. Go out in the street any day and watch the employees of an electric light and power company putting up wires and other equipment. Then go over to the next street and watch the city electricians doing similar work. You will see the difference in the amount of work the company is getting and the amount the city is getting. The company's employees are required to do so much work each day and if they don't they lose their jobs and the company gets other employees who will do better. But with the city it's different, the employees loaf long and waste time and supplies at the expense of the taxpayers.
>
> A private company can discharge inefficient employees, but the city can't. To get rid of inefficient city employees I have to file charges minutely specifying their shortcomings and then the civil service commission puts me on trial instead of the employees. I am a strong advocate of civil service—I think it is absolutely necessary in the administration of government—but there are some defects that must be remedied before the executive will have it in his power to run the government so as to give the people their money's worth.

We do not see that blame can be thus laid on the shoulders of city employees without in some degree affecting those who are over them. If the superintendents and heads of departments in city employ were really held responsible for results, as would be the case in a proper business administration of the city's affairs, it is reasonable to expect that they would find some way of controlling the work of their subordinates.

It is sometimes claimed that municipal management is necessarily inefficient, if not actually corrupt. An illustration showing a contrary state of affairs was shown in an article in our issue of Dec. 5, 1907, describing the results of organizing a Chicago city department on a business basis. The efficiency and economy were proved conclusively, yet the organization has since been abandoned. The general impression (and the natural inference) is that this was due, in part at least, to the influences which had dominated the department in the past, and which would not submit to the loss of certain prerogatives as to the employment of labor and the purchase or use of materials. It is unfortunate that such a retrograde step should have been made by the administration.

In this connection it may be noted that not very long ago the actual theft of city property by employees in the shops of one of the city's departments became to great as to lead to a public investigation. At about the same time the office forces of the same department were investigated and reorganized as the result of the lack of discipline and supervision of the employees. As one result of the investigation, a clock-register system was installed as a check upon the unrestricted comings and goings of the employees, and to require them to spend a proper amount of time in the office. It was received, of course, with much objection, but seems to have effected an improvement. Yet, according to the local papers, the system has been abandoned at the suggestion of the Mayor, who thought it undignified to thus indicate that it was necessary to compel the city's employees to attend to their work. The cause of the neglect and carelessness undoubtedly lies in the lax discipline and the political affiliations which too frequently prevail in municipal offices. It is evident that the primary responsibility for waste of material and time and neglect of duty on the part of municipal employees must lie with the higher officers of the administration and cannot be transferred by them wholly to the shoulders of the employees whom they direct.

THE MOVEMENT TOWARD MUNICIPAL OWNERSHIP OF PUBLIC WATER SUPPLIES.

The vote in the city of San Francisco on Nov. 12, by which the citizens expressed themselves six to one in favor of municipal ownership of the water-supply system, is an event deserving more than passing notice. For many years the cities of New Orleans and San Francisco have been the only ones among the great cities of the United States to rely upon private companies for their water-supply. New Orleans, however, has been for some years at work upon its municipal water-supply system, and it is expected to be in full operation by the close of this year, the system including a complete filtration plant so that the quality as well as the quantity of the supply will be assured. The movement for a municipal water-supply for San Francisco dates back at least eight years, but naturally made little progress during the era of corruption in municipal affairs.

Compared with private water companies generally, the Spring Valley Water Co., which has furnished San Francisco's supply, has been conducted on lines in many respects commendable. Its works are without doubt the largest and most important of any private water company in the United States, and it made as much provision for the city's growth and for storage of supply against contingencies of drought as could well be expected. Since the movement for a municipal supply gathered force, however, the company has naturally refrained from increasing its investment more than was absolutely necessary. It was subjected to heavy burdens, of course, in common with every other industry of San Francisco, by the earthquake and fire. While it could not justly be held responsible for the conflagration, since its mains were broken by the earth shock, there is no doubt that the public opposition to the company was increased by the calamity which the city suffered because of the failure of the supply. Furthermore, it is the general feeling in San Francisco that for the future fire protection of the city the best that money and skill can furnish is none too good. It was hardly to be expected that the company would undertake the large outlay that would be necessary to rebuild its plant on these lines.

The question of rates has long been a bone of contention between the company and the water users. Under the California law, the rate to be paid by water consumers in San Francisco is determined annually by the Board of Supervisors of the city. This action of the public authorities, however, has been nullified by court proceedings on the part of the water company. Each year a temporary injunction has been obtained from the United States Court, on the plea that the rates fixed would deprive the company of its property without due process of law, and the court proceedings consequent upon this injunction have never reached the point of final adjudication. Whether the rates fixed by the supervisors have been unreasonably low or not, the fact remains that the controversy bred enmity toward the water company and was undoubtedly a large factor in bringing about the overwhelming vote for the new municipal supply.

Of course the question of quality entered in, also, as an important factor. The new supply is to be taken from drainage areas in the high Sierra Nevada Mountains so elevated that little or no pollution from habitations is ever likely to take place. Undoubtedly a much better supply will be secured than could possibly be expected from the gathering grounds of the Spring Valley Water Co. located on the [illegible]n Francisco peninsula.

It is worth noting that the ori[illegible]al steps for a better water supply for the cit[illegible]ere directed toward obtaining bids from pri[illegible] companies, and these, in fact, were actually [illegible]cured some eight years ago. The growth of [illegible]ntiment toward municipal ownership, ho[illegible]er, was so strong that further dealings wit[illegible]rivate companies became out of the question. Much credit is due to the faithful work of the [illegible]gineers who have assisted the city authoriti[illegible] in carrying out the plans for the new supply. The original recommendation of these elevated [illegible]rra Nevada sources was made by Mr. C. E[illegible]runsky, M. Am. Soc. C. E., when City Eng[illegible]er of San Francisco, and very recently e[illegible]rt reports favoring these sources have been [illegible]ade by Mr. Desmond FitzGerald and Profes[illegible] Marx, of Stanford University.

Of course the vote on Nov. 12 re[illegible]sents only the first step in the acquisition of [illegible] municipal supply. It empowers the city authorities to take advantage of the favorable action of the Federal Government authorities with respect to securing rights to the waters referred to. It will have to be followed up, of course, by suitable action for the construction of dams and conduits to convey the water to the city, a distance of over 200 miles.

The change of San Francisco and New Orleans to municipal ownership of their water-supplies leaves no city in the United States of more than 110,000 population in the position of relying upon a private company for its water-supply, with the sole exception of Denver and Indianapolis; and in the former city, work for a municipal water-supply is already far advanced. Of the 33 cities having less than 110,000 and more than 60,000 population, the only ones still relying on private companies are Des Moines, Ia., Bridgeport, Conn., Grand Rapids, Mich., Scranton, Pa., Memphis, Tenn., Omaha, Neb., St. Joseph, Mo. New Haven, Conn., Oakland, Cal., and Paterson, N. J. In a number of these cities public dissatisfaction with the company supply is very serious, and a change to municipal ownership is bound to come in no long time.

A PROPOSED INCREASE IN THE CORPS OF ENGINEERS.

All signs point toward a radical enlargement of government work in the improvement of waterways. A national convention is to assemble at Washington early next month and is expected to make a strong appeal for a regular annual appropriation of $50,000,000 by the Federal Government for waterway improvements.

This agitation for improved waterways, as our readers know, has been gathering force for many years. It has secured the approval of the President-elect and of a large proportion of the members of Congress. But in all the discussion little attention has been paid to the question under whose direction this work is to be carried out. Upon the answer to this question the whole success or failure of the movement for improved waterways depends. There are plenty of sloughs and creeks and shallows where fifty million dollars a year can be sunk with no resulting benefit to the country's transportation interests worth talking about. The only practical step toward placing the improvement of national waterways on a sound business basis was the appointment by President Roosevelt of the Inland Waterways Commission; but, as our readers know, the ability of the Commission to do the work for which it was commissioned has been almost nullified by the refusal of Congress to establish the Commission on an official basis and provide it with funds necessary for the work.

As matters stand at the present time, all work which the Federal Government may undertake for waterway improvement must be carried on under the direction of the Corps of Engineers. The annual report of Gen. Wm. L. Marshall, the present Chief of Engineers, has just been made public, and it is of much interest to find that it opens with a strong plea for a radical increase in the membership of this Corps. It may be of interest to our readers to know how the Corps is now constituted. Examination of the directory

of the Corps, issued on Oct. 1 of this year, shows that it is made up of 170 officers, who are divided in rank as follows: One General (the Chief of Engineers), 10 Colonels, 16 Lieutenant-Colonels, 32 Majors, 43 Captains, 43 First Lieutenants and 25 Second Lieutenants. The 27 officers above the rank of major are all, of course, men of mature years. The average age of the 32 majors appears to be about 46 years. The captains may be averaged at about 34 years, and the first lieutenants about 28. If we assume that half of the captains have reached an age and experience at which large responsibilities may be placed upon them, we find that roughly the Corps may be divided into two parts, of which about half are fit for positions of large responsibility and the other half are still at an age when they should be adding to their experience in subordinate positions.

It hardly needs demonstration to prove that the 80 or so older officers of the Engineer Corps would have their hands full if they had nothing but the river and harbor improvements to look after. Gen. Marshall's report, however, shows that a large part of the Corps are required to give their time to other work, and only a comparatively small portion of the whole are engaged on the important work of waterway improvement. Eighty-six officers, or exactly half of the Corps, are engaged on military duty exclusively, and 33 officers in addition have to give part of their time to military work. This leaves only 52 officers of all ranks, from General to Second Lieutenant, to conduct the Federal Government's engineering work. Upon this small band of officers there is now placed by statute responsibilities for the construction of all the coast fortifications, the superintendence and execution of all works for river and harbor improvement, as well as surveys for and reports upon future projected works of this class, the construction and repair of lighthouses both on United States waters and in the island possessions, the municipal engineering of Washington, D. C., the improvement of the Yellowstone National Park, the survey of the Great Lakes and the charting of canals therein, the control of California rivers affected by the debris from hydraulic mining, the construction of the Panama Canal, and a considerable amount of work in connection with the conduct of the various schools maintained by the army.

The condition of overwork in the department is well summarized by Gen. Marshall as follows:

> At present only 44 officers, or about one-fourth of the Corps, are left under full control of the department to attend to the important construction works, fortification, river and harbor, and other, devolving by law upon the Corps of Engineers. Deducting from this number the Chief of Engineers himself, the assistants in his office, and a small allowance for officers sick, on leave, or changing stations, there remains only about one officer for every two engineering districts, whereas there should be in each district at least one officer and in many districts two or more.
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> Owing to the total inadequacy of the number of available officers it has been frequently necessary to combine works and districts and to thus throw upon many officers such a number and variety of duties as to make it difficult, if not impossible, for them to devote to the various items of work the proper amount of detailed consideration. Furthermore, it has become necessary to almost stop the extremely desirable custom, formerly in vogue, of assigning as assistants in construction districts young officers, in order that they may, by actual observation and practice, become fitted to assume charge of construction work, and in several cases recently it has been necessary to assign to the charge of important construction work an officer *who has had no previous experience as an assistant on such work.*—[Italics ours.—Ed.]

Having thus established the absolute necessity of an increase in the number of the men called to bear these large responsibilities, Gen. Marshall makes his recommendation for an increase as follows:

> Under the circumstances, it is evident that if the work of the Corps of Engineers is to be carried on with the same high standard of efficiency that has previously characterized it, there must be an increase in the number of officers in the Corps in order that a greater number may be available for construction work. This matter has been given careful consideration, and a careful canvass has been made of the work to be done and of the number of officers in the Corps available for this work, and as a result of this study I have decided that with the same enlisted strength as at present an increase of 60 in the authorized number of engineer officers is absolutely necessary to provide a sufficient number of officers for the work now devolving on the Corps. Furthermore, the increase on this account should be only in the grades above that of second lieutenant, as officers of that grade are not available for and should not be assigned either to the charge of construction work or as assistants thereon.
>
> By an increase of 60 officers, affecting only the grades above that of second lieutenant, and distributed among those grades in proportion to the number of officers at present in each grade, there would be added to the authorized strength of the Corps of Engineers 4 colonels, 7 lieutenant-colonels, 13 majors, 18 captains, and 18 first lieutenants, which is the additional strength estimated on account of the large increase in civil work of the Corps.

Gen. Marshall then turns to the need of additional engineer officers for purely military duties. He shows that the demand for engineer troops is very rapidly increasing. It is stated that the General Staff is about to recommend an increase in the number of engineer battalions of enlisted men from three to six, and to officer these battalions 57 additional officers will be required. He also recommends that the battalions be organized into regiments requiring 15 additional officers, or a total increase of 132 in the personnel of the Corps of Engineers.

We are sure that no one will be found among those familiar with the duties laid upon the Engineer Corps, who will in any way deny the necessity for the increase in the number of officers recommended by Gen. Marshall. But the point on which division of opinion is certain to arise is the question, how shall this increase be made? The widely published newspaper abstracts of Gen. Marshall's report left no hint as to his recommendations on this point, and we therefore print in full his solution of this problem.

> This increase, though apparently large, I believe to be essential to equip the Engineer Corps with officers sufficient to enable it to perform properly the numerous and important duties devolving upon it. It is, however, evident that this increase cannot, without causing confusion, be made at once, and if made by permanent transfers without trial, it is probable that it cannot be made at all without getting in some undesirable material. I would, therefore, recommend that the increase be made to extend over a period of about five years, and in the higher grades by promotion of officers now in the Corps and in the other grades by assignment of graduates of the Military Academy and by detail, for a term of years, of officers who have graduated from the academy and are selected from the army at large, officers thus detailed who may prove to be satisfactory to be permanently commissioned in the Corps of Engineers under such regulations as to grades and dates of commission as will equitably preserve their rights and those of officers previously in the Corps.

Gen. Marshall is by his professional achievements entitled to rank as an engineer of ability and distinction; but his plan for increasing the membership of the Corps of which he is at the head indicates that military traditions had greater weight with him than the need for the solution of engineering problems by men of professional ability. Referring to his recommendations above, we presume that Gen. Marshall would place the officers from the other departments of the army in charge of the purely military duties in the Corps. It is simply unthinkable that an officer of infantry or of cavalry, with no other knowledge of engineering than what he gained as a boy at West Point and the little he may have picked up since, should be placed in charge of important works of river and harbor improvement. If we are correct in this assumption, then Gen. Marshall's proposition is to make the needed increase in the Corps of Engineers for purely civil engineering work by simply shoving up the young lieutenants and young captains and placing them over work which ought to be, as Gen. Marshall himself says in substance, in the charge of men of large ability and long experience. In the interest of sound engineering, in the interest of the nation, which should have its appropriation for waterway work efficiently expended, we protest against such a plan.

Engineering News has fully recognized and often pointed out the very valuable services which officers of the Corps of Engineers have rendered and are rendering in the efficient and honest conduct of great public works. Yet we have at the same time recognized the fact that a large part of the real engineering work is being done by subordinates, with inadequate pay and inadequate position. The character of the work done and its ultimate cost to the public has suffered in the past and is bound to suffer very much more in the future if a change is not made.

We believe that Gen. Marshall has missed a great opportunity. If a radical increase is to be made in the membership of the Corps of Engineers—and no one doubts its necessity, if that body is to continue in charge of Federal waterway work—then why not make that increase *by selecting the men best competent to fill the positions*?

The United States selects its officers to replenish the Civil Engineer Corps of the navy from engineers in civilian life, and there is no question about the *esprit de corps* of this body of officers or its efficiency and ability. There is absolutely no reason why the proposed increase in the Corps of Engineers should not be made by the appointment of men who have served as civilian assistant engineers in that work and who have thereby acquired an experience in that field of engineering possessed by no other set of men. Such appointments would come as a well-deserved promotion to many of these men; but we urge them not on their account but on account of the need for greater efficiency and economy in the work of waterway improvement.

It may be said that the excellent traditions of the Corps of Engineers in the past ought to be maintained. There is one tradition, however, that ought not to be maintained, and that is the tradition of caste: The tradition that the West Point graduate, and the West Point graduate alone, can aspire to a commission in the Corps of Engineers, while the civilian engineer, who has obtained his education at schools which are far superior of West Point in their engineering training, cannot possibly, no matter what his ability, be promoted to a position in the Corps.

The absurdity of this tradition is still more evident when we reflect that it does not obtain in other departments of the army. There are not a few cases where enlisted men have, by sheer ability, risen grade by grade until they have become officers in the infantry, cavalry or artillery. Besides these men, there are a number of the present line officers who entered the army directly from civil life at the time of the Spanish War.

We reveal no secrets when we say that there is a strong feeling among many influential men who are active in the present movement for increased waterway facilities, that the Government's civil engineering work should be removed entirely from the jurisdiction of the Corps of Engineers. There are some reasons why such a change might be an unwise one, as has been fully pointed out in this journal at various times. But if the Corps of Engineers persists in its policy of exclusiveness, and will take no steps looking to reorganization on a broader plane, it cannot complain if a radical revision is made in its duties.

LETTERS TO THE EDITOR.

Specifications for Macadam Road Construction.

Sir: In your issue of Nov. 5 you publish a series of "Specifications and Notes on Macadam Road Construction" by Mr. A. N. Johnson, Assoc. M. Am. Soc. C. E. There are a number of points in this article which seem open to challenge, one or two of which I would like to mention.

The slighting reference to "telford construction" seems unjustified, and Mr. Johnson entirely omits mentioning the chief reason for the use of the "telford construction"—namely "drainage." In the construction of macadam roads where subgrade is impervious material such as clay and where there is present more or less ground water due either to springs or run-off from neighboring high lands, the use of the telford base would seem to more than justify itself. This is simply one place among

many where a telford construction or else some adequate underdrainage is imperative and would in itself justify telford construction.

In the specifications for telford, Mr. Johnson makes this statement: "Should any unevenness or depressions occur during or after the rolling of the first course, they are to be remedied immediately by broken stone and rolled firm."

This would seem to the writer to be very bad practice. If the sub-grade is properly rolled in the first place, there seems no reason at all why there should be any depressions in the telford if properly laid. If such depressions occur, they will, of course, be depressions in the sub-grade, in which case the telford should be taken out and the sub-grade brought up and properly compacted. If, as Mr. Johnson specifies, the telford is allowed to sink and is further depressed by being covered with broken stone and rolled, there will develop a cup in the sub-grade which will hold water and will result in a soft spot in the road.

The requirement that each of the two main courses of stone which are specified should be raked and so handled that all the finer material settles to the bottom seems very hard to justify. It can be readily seen that if this is done with both courses, there will be two planes of finer material dividing the specified size stone of the two layers and the advantage of this is hard to understand.

The desire for having 3-in. stone in the second course immediately below the screenings also seems unusual. It would be obviously impossible to roll 3-in. stone to any fair degree of compactness and the interstices would therefore be large and would have to be filled with the screenings, which would mean a very unequal thickness of screenings and would result, in a comparatively short time, in the appearance through the screening surface of the points of the large stones.

Mr. Johnson seems to generally discredit the idea of grading the stone from the bottom up with the larger material on the bottom, but as the object is to obtain not only a good bearing surface but to keep that surface dry and well drained, it certainly seems that such a construction is reasonable.

In the question of payment for macadam construction, Mr. Johnson speaks of the difficulty of preventing scrimping by the contractor, when paid on the basis of the square yards of surface. In this connection I would say that there is another method which seems to have an advantage and that is: requiring the contractor to submit his shipping bills for stone. As these give the weight of stone he has used, it is not difficult to arrive at a fairly accurate idea as to whether or not there has been any extensive slighting of the work.

Yours very truly,

Norman E. Olds.

103 Richmond St., West, Toronto, Ont., Nov. 12, 1908.

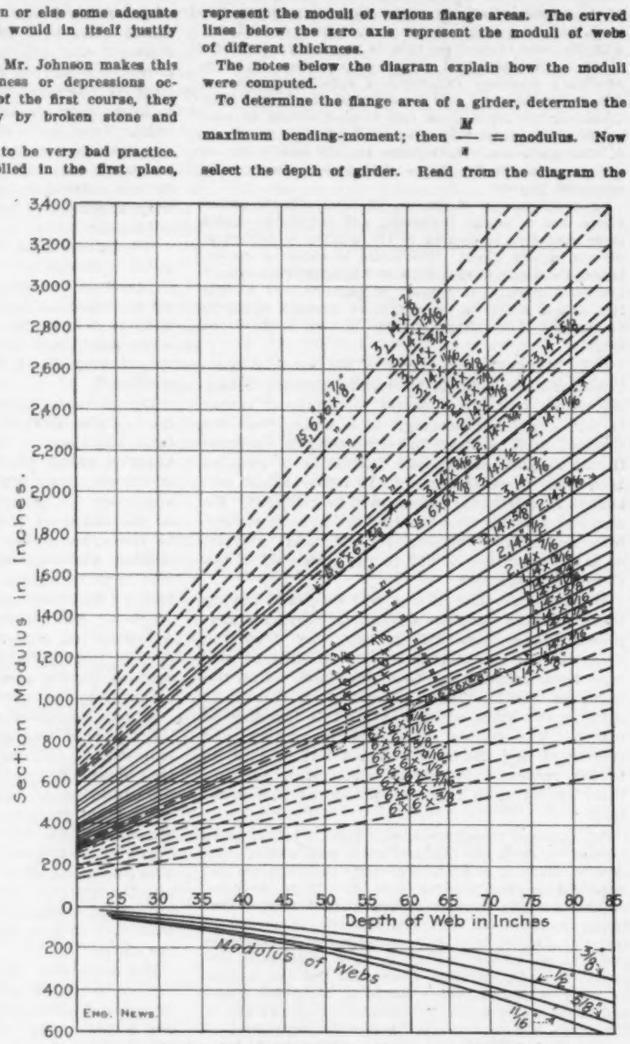
A Section-Modulus Diagram for Plate-Girders.

While designing girders I compiled a diagram which saves considerable time and labor and at the same time secures uniformity of design. I noticed that in our construction the great majority of girder flanges were made up of 6 × 6-in. angles and covers, and thus hit upon the accompanying diagram, which has been found very useful in my office.

A brief description will suffice. The moduli are recorded above and below the zero axis, to a scale [in the original] of 400 = 1 in. The depth of the web, in inches, is measured from left to right [original scale 10 ins. = 1 in.]. The inclined lines above the zero axis represent the moduli of various flange areas. The curved lines below the zero axis represent the moduli of webs of different thickness.

The notes below the diagram explain how the moduli were computed.

To determine the flange area of a girder, determine the maximum bending-moment; then $\frac{M}{s}$ = modulus. Now select the depth of girder. Read from the diagram the



A SECTION-MODULUS DIAGRAM FOR PLATE GIRDERS.

Diagram computed from the following:

If M = external bending-moment

S = permissible fiber stress then Required Modulus = $\frac{M}{S} = A_1 d_1 + A_2 d_2$

where A_1 = section area of flange-angles (one flange).
A_2 = sectional area of cover-plates (one flange).
d_1 = distance between centers of gravity of flange angles.
d_2 = depth of web plus ½-in.

Deduction for rivet-holes:
For flanges without covers, 1 hole for ⅞-in. rivet out of each angle.
For flanges with covers, 2 holes for ¾-in. rivets out of each angle and each cover plate.

The curves below the zero axis give the section-modulus of the web, counting one-eighth the web area as flange area.

section nearest to or just above the point where the vertical and horizontal ordinates intersect. For example $\frac{M}{s}$ = 2,000 and depth of web is 60 ins. The line passing nearest the intersection of these two ordinates represents a flange composed of two 6 × 6 × ⅝-in. angles and three 14 × ⅝-in. covers.

If it is desired to include one-eighth of the web as flange area, find the modulus for the web below the zero axis, subtract it from the total required modulus, and determine the required flange section as above.

Similar diagrams may be made for other angles and suitable covers.

The lengths of cover plates are determined in the usual way.

L. R. Shellenberger.

21 West 45th St., Bayonne, N. J., Oct. 27, 1908.

[The diagram is, of course, equally applicable to lattice-girders as to plate-girders.—Ed.]

GAS METERS TESTED by the Public Service Commission of New York City during the month of October numbered 30,882, of which 6,594 were new, 23,739 repaired, and 549 complaint meters. Of the 549 complaint meters tested, 56, about 10%, were correct; 328, or 60%, were fast, and 165, or 30%, were slow.

A STUDY OF RAIL PRESSURES AND [illegible]RESSES IN TRACK PRODUCED BY DIFFERENT [illegible]TYPES OF STEAM LOCOMOTIVES ON CURVES.*

By E. E. STETSON.†

[Preface by W. C. Cushing, M. Am. Soc. [illegible] E., Chief Engineer of Maintenance of Way of the [illegible]nsylvania Lines (Southwest System), Pittsburg, [illegible]

It is well known that the problem of [illegible]lating the stresses produced in track fastenings is p[illegible]tically indeterminate. But in order to compare the [illegible]nable difference in effect of different types of locom[illegible]es, it may not be a bad plan to endeavor to make as c[illegible]e an analysis as possible, with the hope of at least th[illegible]ing some light on the different effects which may be [illegible]duced. If this be not done, we must either resort to e[illegible]iment, or determine the matter by watching the effe[illegible] produced in actual service.

Making accurate experiments has turned [illegible] to be a very difficult thing, and cannot always be resorted to, as the apparatus required is both costly and [illegible] troublesome to get, and the experiments require the most painstaking care and great expenditure of time. It is undoubtedly desirable, nevertheless, to have all the experimental data possible, and this source of information is of great value if the experiments are properly and scientifically conducted.

Waiting for results from actual service is the usual way the maintenance-of-way engineer has had to gain information for the design of track fastenings. The method is unsatisfactory, as it leads to more or less work in the dark. In spite of this unscientific method, it will continue to be more or less used, because the solution by mathematics is indeterminate on account of the many assumptions which must be made. This is unfortunate, because we all realize how much more satisfactory it would be if we could calculate in advance the probable effect of a new type or weight of locomotive, without waiting for the results of exhaustive experiments or actual service.

Nevertheless, with the hope that the uncertainties may be from time to time reduced to smaller limits, and a more correct analysis evolved, the subject is opened up for discussion by the members of the American Railway Engineering and Maintenance-of-Way Association through the following paper by E. E. Stetson, of the engineering department of the Pennsylvania Lines. He has endeavored to work out a formula for determining the stresses in track fastenings as nearly as possible, and has then compared the probable effects of different types and weights of some heavy locomotives on them.

A locomotive when rounding a curve exerts certain forces which produce stresses in track that do not exist on a tangent. These forces arise from two causes: centrifugal force, and forces arising from the tendency of the locomotive trucks to continue in a straight line. They may be further classified into three fundamental forces:

(1) Net effect of centrifugal force (superelevation of outer rail considered).

(2) Lateral slipping or component of slipping in direction of radius due to curvature.

(3) Longitudinal slipping or component of slipping in direction of tangent of track due to unequal rail lengths inside and outside.

These forces are resisted by the pressure of the flange of the outer wheel against the rail, thereby producing a horizontal thrust against the outer rail. This thrust in turn is resisted by friction of base of rail on ties or tie-plates, and resistance of fastenings to shearing and resistance of wood to crushing behind spikes. It is therefore necessary to compute the magnitude of this flange pressure or horizontal thrust and then find the resultant horizontal force acting on heads of spikes at a tie. The method of computing this force, and upon which all the calculations have been based, will now be outlined.

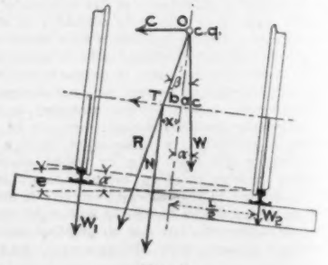


Fig. 1.

The first step is to compute the wheel loads on the rail from the given axle load for a given degree of curve, speed and superelevation. In computing these wheel loads, the assumption has been made that the height of

*From Bulletin No. 104 (October, 1908) of the American Railway Engineering and Maintenance-of-Way Association, Chicago.

†Engineering Department, Pennsylvania Lines, Union Station, Pittsburg, Pa.

the center of gravity of the total axle load above rail is equal to the height of the center of gravity of the whole locomotive above the rail. Starting with this assumption, the height of the center of gravity of the spring-supported portion of the load above the axle is computed for each axle. The centrifugal force is considered applied at the point and is combined with spring-supported load. The resultant is resolved into two components at the point where it intersects the axle, normal and tangential to the axle. The part of the normal component carried by each wheel is next computed, and the total wheel load is then found by adding one-half the weight of axle and wheels to each.

The mathematical computation of the portion of the spring-supported axle load carried by each wheel is shown below:

Referring to the diagram in Fig. 1,

W = spring-supported part of axle load.

C = centrifugal force $= \frac{Wv^2}{gr}$ where v = velocity in feet per second $g = 32.16$ and r = radius of curve.

e = superelevation of outer rail.

L = distance between points of contact of wheel treads on rail.

Angle of superelevation $\alpha = \tan^{-1}\frac{e}{L}$.

Combining centrifugal force C and weight W, resultant $R = \sqrt{W^2 + C^2}$.

Let β = angle R makes with vertical $= \text{angle bOc} = \tan^{-1}\frac{C}{W}$.

Angle aOc = α (similar triangles).

Angle aOb = $\beta - \alpha$.

Now resultant R intersects wheel axle at point b distant $ab = x$ from center.

$x = aO \tan(\beta - \alpha)$ where aO = height of center of gravity of locomotive above rail minus distance between top of rail and axle.

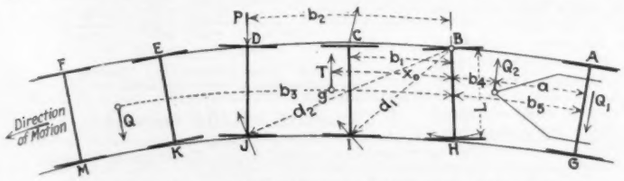


FIG. 2. DIAGRAM OF TRACK STRESSES UNDER PACIFIC TYPE LOCOMOTIVE.

At point b, where R intersects axle, resolve R into two components, N and T, normal and tangential to axle, then $N = R\cos(\beta - \alpha)$ and $T = R\sin(\beta - \alpha)$.

W_1 the normal load on outer wheel $= \frac{\frac{L}{2} + x}{L} N$, and W_2 normal load on inner wheel $= N - W_1$.

To the values thus found for W_1 and W_2 should be added $\frac{W^1\cos\alpha}{2}$ where W^1 = weight of axle and wheels.

Since α is always small, however, it will be sufficiently accurate to take $\cos\alpha = 1$ and simply add $\frac{W^1}{2}$. In computing the wheel loads for the guiding and trailing trucks, the same method of procedure is followed. In their case, however, a greater proportion of the load goes to the outer wheel, due to displacement of bearing plates between the trucks and frame of locomotive. The amount of this displacement for any case can be obtained from the following formula: $s = 2a\sin\frac{1}{2}I$ where s = displacement in inches, a = distance from forward or rear driver to center of bearing plate in inches, and $I = \frac{(a+b)D}{200\times 12}$ where b = total rigid wheel base in inches and D = degree of curve.

The next step is to draw a diagram as in Fig. 2, showing the position the wheels of the locomotive are assumed to take and then analyze the forces acting. The forces acting and stresses produced will, of course, be different for different types of locomotives. For this discussion, a Class A (Pacific type) locomotive has been chosen, as shown in Fig. 2.

The wheels of the locomotive in rounding a curve are assumed to take a position as shown in Fig. 2. The locomotive as a whole, that is, the driving-wheel base and frame, is assumed to revolve about the outer rear driving wheel B, as it requires less work to slide the inner wheels than the outer wheels, due to the fact that there is less load on them. A pressure must be applied through the wheel flanges against the rail sufficient to slide the rigid wheel base and cause the locomotive to follow the curve.

In the case of the forward truck, the force necessary to turn the truck will be applied at the front outer wheel. In the case of the driving-wheel base, however, there are two conditions: (1) where the flange of the second outer driving wheel cannot bear against the rail, the play of drivers in frame being less than departure of the curve at that point; (2) where play of second pair of drivers in frame is sufficient to allow flange of wheel to bear against rail.

The first condition will, of course, give the worse case, as then all the thrust against the rail from the driving-wheel base is applied at one point, viz., the outer wheel of front driver.

Assuming condition (1) to exist, it is required to calculate what this thrust P on front outer driving wheel will be.

ANALYSIS OF FORCES ACTING ON LOCOMOTIVE FRAME AND RIGID DRIVING-WHEEL BASE.—The locomotive is pivoting about E, and, to do this, inner wheels H, I and J must slip laterally in and longitudinally backward, due to smaller radius, since wheel base is rigid. Wheels C and D would also have to slip laterally, but the slip of wheel D would be self-contained, and would not produce outward thrust on the rail at D. The force necessary to produce slippage of wheels on the rails is the product of the coefficient of friction between wheel and rail and the actual wheel load, which latter is readily computed, as shown in Fig. 1.

Designating the value of this coefficient by f, then there are acting at H, I, J and C forces equal to product of actual wheel loads W_h, W_i, W_j, W_c, and f. These forces act in direction of arrows. There is also acting at C. G. of whole locomotive a force T acting outward equal to unbalanced centrifugal force computed in same way as T in Fig. 1 was computed, using for W the total weight of locomotive less weight of guiding and trailing trucks. Then at the bearing plate of the forward truck where load is transmitted from body of locomotive to truck there is a horizontal force Q acting on body of locomotive. The nature and amount of this force depends upon radius of curve and amount of lateral play that the pin, connecting truck with body, has in truck. If, as is generally the case, the lateral play is greater than the displacement of bearing plates between trucks and frame of locomotive as computed from formula previously stated, then the truck will not bear against pin, and the only force acting on body of locomotive will be the frictional resistance of bearing plate against shifting, or Q = product total weight on truck minus weight of truck itself and coefficient of friction f^1 between bearing plates.

The weight on the trailer is transmitted from the frame to the trailer through bearing plates directly over the axle. On entering and leaving the curve, and possibly through central part of curve, these plates will slide on one another and produce a force Q_1, acting on frame of locomotive at this point in the direction of arrow, and equal to product weight on trailer minus weight of trailer itself, and coefficient of friction f^1 between bearing plates.

At the pivot of the trailing truck there is a force Q_2 acting on the frame transmitted from the truck through the pin. This force Q_2 in combination with an equal pressure of flange of wheel against rail prevents the trailing truck from rolling in a straight line and causes it to follow the curve. To do this, wheel G has to be slipped longitudinally, which requires a force of fW_g acting at G. To determine value of Q_2 take moments about A, then $Q_2 a = fW_g L$, or $Q_2 = \frac{fW_g L}{a}$.

Now taking the summation of the moments about B of all the forces found acting and outlined above and placing equal to zero, the resulting equation, which can be solved for P, the pressure against the rail at D, is $fW_h L + fW_1 d_1 + fW_2 d_2 + Tx_0 - Pb_2 + fW_c b_1 + Q_1 b_3 - Qb_3 - Q_2 b_4 = 0$, or

$$P = \frac{fW_h L + fW_1 d_1 + fW_2 d_2 + fW_c b_1 + Tx_0 + Q_1 b_3 - Qb_3 - Q_2 b_4}{b_2}$$

This outward thrust P is resisted by friction between base of rail and tie plate and shearing stress in fastenings.

Shearing stress in fastenings $= P - fW_d$, and assuming this stress distributed over two ties, total shearing stress in fastenings at one tie produced by forward outer driving wheel of Class A locomotive assuming flange second drivers not to bear against rail $= \frac{P - fW_d}{2}$.

Assuming now that condition (2) exists, then the radial slippage of wheels C and I will not cause pressure against rail at D, and the unbalanced centrifugal force will be distributed over three drivers instead of two. P will, therefore, be reduced by an amount $=$

$$\frac{fW_c b_1 + fW_1 \frac{L}{d_1} b_1}{b_2} + \frac{T}{6}$$

The outer thrust against rail at outer front wheel of guiding trucks should next be computed.

Truck is assumed to pivot about E (Fig. 3), since it is easier to slip wheels M and K than wheels E and F. Wheels M and K must then slip laterally inward and longitudinally backward. Wheel F will slip laterally, but slippage will be self-contained and will not produce any outward thrust against the rail at F.

The forces necessary to produce slipping of wheels are as before the product of actual wheel loads and coefficient of friction f. They are fW_m and fW_k and act in direction of arrows. At the bearing plate there is a force Q acting in the direction of arrow, due to frictional resistance of bearing plates. This force equals product of weight on bearing plates and f^1 the coefficient of friction between plates. There is also the unbalanced centrifugal force $T = W\sin(\beta - \alpha)$ acting at center of gravity of truck, W being the weight of truck.

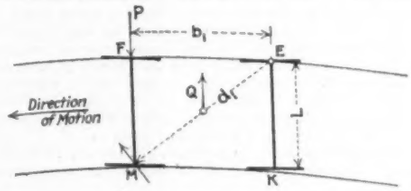


Fig. 3. Diagram of Track Stresses Under Guiding Truck.

Now the moment of these forces about E must be opposite and equal to moment of P about E, or

$$P_1 b_1 = fW_k L + fW_m d_1 + Q\frac{b_1}{2} + \frac{b_1 T}{2},$$

or $$P_1 = \frac{fW_k L + fW_m d_1 + Q\frac{b_1}{2}}{b_1} + \frac{T}{2}$$

This thrust P_1 is resisted by friction between base of rail and tie plates and the shear on fastenings.

Then shear on fastenings at $F = P_1 - fW_f$ and assuming this shear distributed over two ties:

Shear on fastenings in one tie caused by guiding truck $= \frac{P_1 - fW_f}{2}$.

This analysis has necessarily been confined to one type of locomotive—Class A—but in the computed stresses produced by the Class B and C engines, which will be given later, the same method of procedure has been followed. In all the cases considered the thrust exerted against the rail at both the guiding truck and driving-wheel base has been computed, and in a few cases the maximum shear on fastenings at one tie has been found to occur at the front wheel of guiding truck.

In all calculations the value of f, the coefficient of friction between base of rail and the tie plates, has been taken as 0.25. The value of f^1, the coefficient of friction between bearing plates of guiding and trailing trucks and body of locomotive, has been assumed as 0.16. Morin gives the value of f^1 for metals on metals dry and perfectly smooth to be from 0.15 to 0.20, while Trautwine gives value of f^1 for steel on steel dry and smooth to be 0.14. Since the smaller the value assumed for f^1 the greater will be the computed thrust against rail at forward driver, the value 0.16 was taken for these calculations.

Computations have been made for the three different classes of locomotives according to the method just outlined for sixteen different cases, and a tabulated statement of results is given in the accompanying print marked Table I. The results given for the Class A locomotive are those obtained under the assumption that the flange on the outer wheel of the middle driver does not bear against rail. For some of the cases considered this is, undoubtedly, not true, for assuming the play of driver in hub to be ½-in., which is the amount of play given them when first put in service, then for all curves of less degree than 2 degrees 30 minutes it is possible for flange of middle driver to bear against rail. Taking play in hub as ¾-in., it will be possible for flange of middle driver to bear against rail on all curves of less degree than 15 degrees 0 minutes. Owing to uncertainty of the amount of play, however, it was thought best to give here the results obtained from assuming that in no case will the flange of middle driver bear against rail.

In computing the maximum shear on fastenings, the horizontal thrust has been assumed to be distributed by the rail over two ties. This is a very conservative assumption, for it seems very reasonable to suppose that the stiffness of the heavier weight rails will distribute the pressure over three or more ties.

In comparing the effects of the three types of locomotives it is seen from the table that with regard to thrust against rail at outer wheel of front driver, Class C gives results about 20% higher than Class A or Class B type, while the thrust produced by the Class A and Class B engines are approximately the same. It can be easily understood how the stress produced by the Class C

engine should be greater than that produced by the Class A or Class B, since it has a much longer rigid driving-wheel base and a greater number of wheels to be slipped than the other two. It is not so self-evident, however, why the forces exerted by the Class A locomotive are no greater or so little greater than those exerted by Class B, since the former has a longer rigid wheel base, a greater number of drivers and a greater total weight than the latter. This may be explained by the difference in amount of loading on, and arrangement of, the guiding and trailing trucks in the two types. The Class A engine has a much greater weight on its guiding trucks than the Class B. Also the distance from the rear driver to trailer in the Class A type is much less than the distance in the Class B. In short, the effect of the guiding and trailing trucks, which tends to reduce the thrust at the front driver, or what may be called the guiding effect in the Class A type of locomotive, is about double what it is in the Class B type. With regard to thrust against rail at outer front wheel of guiding truck, it is seen from the table that the Class A guiding truck produces results about 50% larger than Class B, and about 35% larger than Class C.

The maximum shear on fastenings in one tie, in nearly every case where there is no unbalanced centrifugal force, is produced by a Class A locomotive, while in cases where there is unbalanced centrifugal force, Class C produces maximum shear.

It will be noticed from the table that the maximum shear on the fastenings in one tie is 8,800 lbs., and is produced by a Class C locomotive rounding a 4-degree curve, the outer rail of which is elevated 8 ins., at a speed of 70 miles per hour, a speed which is not likely to be reached by this class on that degree of curve.

It will be noticed in the preceding Table I. that in nearly every case the horizontal force exerted at outer front wheel of guiding truck decreases very slightly as the speed and curvature are increased. This is due to the fact that as speed and curvature are increased, weight on inner wheels decreases, and they are then more easily slipped. The resultant force acting on rail at outer wheels of guiding truck increases, however, in every case with increase in speed and curvature, as is shown in Tables II., III. and IV., which follow.

The vertical, horizontal, and resultant forces acting on rail at outer wheel of forward driver and front wheel of guiding truck are given in Tables II., III. and IV., and also the distribution of the resultant pressure at base of rail for A. S. C. E. 100-lb. and 85-lb. sections, and Pennsylvania System 100-lb. and 85-lb. sections. In computing the amount and position of the resultant force on the rail at outer wheel of front driver, the effect of the non-balancing of the counterweight on the driver was taken care of in the following manner: The "dynamic augment," or the force produced by the unbalanced weight, was found in terms of the static wheel load and the speed for the three classes of locomotives; the static wheel load was decreased by an amount equal to this force when counterweight is up and increased by the same amount when counterweight is down. For the computations in these tables the counterweight was considered up, because the smaller the vertical force the less favorable the position of the resultant and the distribution of pressure at the base of rail. The dynamic augment was found to be equal to $.007\ V^2W$ for Class A and Class B locomotives, and $.013\ V^2W$ for Class C, where V = speed in miles per hour and W= static wheel load. A study of these three tables discloses at once the fact that in many cases the resultant falls entirely outside the base of rail. At the guiding truck of the Class A and Class B locomotives this happens for every case. It also occurs at the outer wheel of front driver for all three locomotives in the cases of greatest curvature and speed. At first thought the question might naturally arise as to what keeps the rails from overturning, if the resultant passes entirely outside the base. If the rail were in sections only a few feet long, and these sections were not rigidly connected together, this undoubtedly would happen. Actually, however, the rails are in 30-ft. or 33-ft. sections and are rigidly connected together. Now, in order to overturn a rail, it is necessary to fracture the rail in two places and pull out all the spikes on inner side of rail between the fractures, or twist the rail at some distance on each side of point of application of forces and pull out the intermediate spikes on inner side. It should also be noted in this connection that in case of both guiding trucks for Class A and B, and front wheel of drivers, there is acting at about 6 ft. back of the point of application of the resultant, a heavy vertical force without any corresponding horizontal force, which will securely anchor the rail against overturning at that point. It will be seen, then, that in order to actually overturn the rail, or a portion of it, a fracture or distortion must take place in the rail, which will require a very much larger force than any found in the table.

All the forces exerted on the rail by these types of locomotives having been found, the next step is to find out how they are resisted by the track fastenings; that is, by ties, tie plates, and spikes. In this connection an investigation will first be made to determine whether wood back of spike will crush before spike will shear, or vice versa. A general equation will now be worked out between the crushing stress per square inch, f_c, in wood, and the horizontal force P, exerted in a spike by the rail.

In Fig. 4 it is seen that a 6-in. spike, used with an A. S. C. E. section rail and a tie plate, will extend into the wood about 4¾ ins. Assume now that the horizontal force P transmitted from rail to spike is distributed over wood back of spike, as indicated in figure; that is, assume that pressure is maximum where spike enters wood, and decreases uniformly to zero at end of spike, and that resultant pressure against wood equals P and acts at a distance below top of tie equal to one-third length of the portion of spike extending in the wood.*

Let f_c = the maximum crushing stress per sq. in. in wood; then $\frac{f_c \times 4.75}{2} \times \frac{5}{8} = P$, or $f_c = \frac{16\,P}{23.75} = 0.674\ P$ (1). Assume now that the ultimate shearing strength of a ⅝-in. spike is 19,000 lbs., this being the average value of the same obtained by Robert W. Hunt & Co. in tests made by them recently for the New York Central & Hudson River Railroad. The value of P, then, which develops the full shearing strength of a spike, is 19,000 lbs. Substituting 19,000 lbs. for P in the equation (1), $f_c = 0.674 \times 19{,}000 = 12{,}800$ lbs. This means that before a spike will shear off, a crushing stress of 12,800 lbs. per sq. in. will be developed in wood back of spike at top of tie.

Some values for the ultimate crushing strength per sq. in., endwise of grain, of the various woods used as ties, and the authority for the same, will now be given:

Beech, 6,800 lbs.—Average of tests made at Watertown Arsenal in 1883 on small and well seasoned pieces.

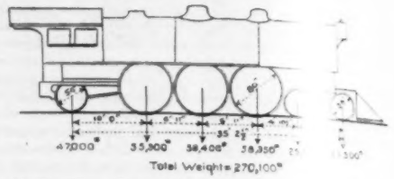
Beech, 3,280 lbs.—Average of tests made at Watertown Arsenal in 1894 on larger and not well seasoned pieces.

*[This neglects the fact that a pressure on the inside of the spike near the bottom is also active; the forces shown in Fig. 4 are not balanced as to rotation. This additional force increases the outward pressure and decreases the compressive area, both effects being to increase the stress f_c at the top. Calculated in this way the real value of f_c is just twice that given in the text, i. e., $f_c = 1.34\ P$.—Ed.]

TABLE I.

Degree of Curve	Speed in Miles per Hour	Superelevation of Outer Rail	Speed Corresponding to Superelevation	Thrust Against Rail at Outer Wheel of Forward Drivers			Thrust Against Rail at Outer Front Wheel of Guiding Truck			Maximum Shear on Fastenings in One Tie, Assuming Thrust Distributed over Two Ties		
				Class A	Class B	Class C	Class A	Class B	Class C	Class A	Class B	Class C
1	60	2.43	60	11120	11500	13180	9520	5970	6900	3160	2200	2940
	70	2.43	60	12830	12950	14700	9420	5960	6910	3060	2870	3630
2	60	4.87	60	11160	11520	13250	9520	5970	6900	3130	2200	2970
	70	4.87	60	14340	14380	17400	9320	5920	6910	3370	3520	4915
3	60	7.30	60	11200	11570	13600	9500	5980	6900	3120	2190	3125
	70	7.30	60	16360	15870	19400	9220	5880	6910	4280	4180	5825
4	40	4.32	40	11140	11550	13050	9470	5940	6850	3100	2220	2870
	50	6.76	50	11180	11580	13300	9480	5950	6870	3100	2220	2980
	60	8.00	54.4	16850	14320	17750	9350	5920	6820	4600	3690	5075
	70	8.00	54.4	21400	20200	25800	8930	5800	6960	6590	6150	8800
5	40	5.41	40	11170	11530	13100	9420	5940	6840	3070	2220	2895
	50	8.00	48.7	12550	12300	14500	9370	5940	6850	3100	2550	3540
6	40	6.48	40	11200	11550	13400	9400	5940	6800	3050	2210	3030
	50	8.00	44.4	15320	15080	18400	9200	5900	6880	3810	3810	5360
7	40	7.57	40	11300	11600	13500	9370	5900	6800	3020	2220	3070
	50	8.00	41.2	18850	18150	22500	8890	5840	6880	5430	5230	7290

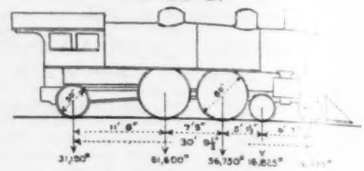
CLASS A.



Total Weight = 270,100#

Pacific Type Locomotive. Front truck has 2¼" swing laterally. Trailer has 2¼" swing. Center of gravity taken as 76½" above the rail.

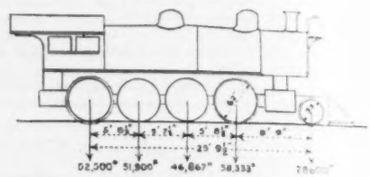
CLASS B.



Total Weight = 183,150#

Atlantic Type Locomotive. Front truck has 2¼" swing laterally. Trailer has 1½" swing. Center of gravity taken as 70½" above the rail.

CLASS C



Total Weight = 238,200#

Consolidation Type Locomotive. Guiding truck has 6" swing laterally. Center of gravity is taken as 62" above the rail.

Diagram of Standard Pennsylvania R. R. Locomotives.

(Showing axle-loads and dimensions of wheel bases.)

Beech, 7,733 lbs.—According to Hodgkinson. (Size of test pieces and condition of wood not known.)

Catalpa (common), 5,180 lbs.—Average of tests made at Watertown Arsenal in 1883 on very small and well seasoned pieces.

Catalpa (common), 2,393 lbs.—Tests made by Newhall on wood in green condition.

Catalpa (hardy), 5,800 lbs.—Average of tests made at Watertown Arsenal in 1883 on very small and well seasoned pieces.

Catalpa (hardy), 1,768 lbs.—Tests made by Newhall on wood in green condition.

Cedar, 3,500 lbs.—Tests made by Forest Service.

Cedar, 3,500 lbs.—Values recommended by A. L. Johnson, in Bulletin No. 12 of Division of Forestry.

Chestnut, 3,500 lbs.—Tests made by Forest Service.

Chestnut, 4,000 lbs.—Kidder's Handbook.

White Oak, 4,000 lbs.—Average of six tests on full-size pieces made at Watertown Arsenal in 1896.

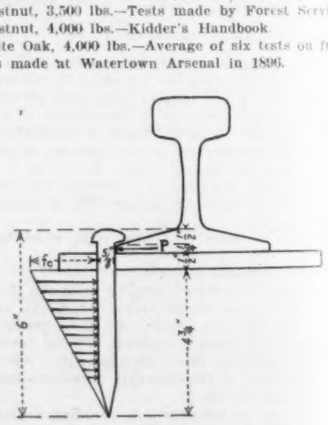


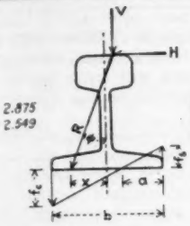
Fig. 4.

White Oak, 4,000 lbs.—Value recommended by A. L. Johnson.

White Oak, 3,470 lbs.—Average of tests of full-sized columns made at Watertown Arsenal under direction of Prof. Lanza.

Yellow Pine (long leaf), 4,000 lbs.—Tests on full-size posts at Watertown Arsenal in 1904.

Yellow Pine (long leaf), 4,544 lbs.—Average of tests on full-size columns made at Watertown Arsenal under direction of Prof. Lanza.



k_x for A.S.C.E. Section = 2.875
" " " = 2.549

k_x for P.S. 100 lb. Section = 2.500
" " " 85 " " = 2.313

TABLES SHOWING AMOUNT, POSITION AND DISTRIBUTION FOR A. S. C. E. & P. S. SECTIONS, OF RESULTANT PRESSURE ON BASE OF RAIL FOR VARIOUS CURVES AND SPEEDS.

TABLE II.—CLASS A LOCOMOTIVE.

Degree of Curve	Speed in Miles per Hour	At Outer Wheel of Front Drivers: H	R	θ	Width of Section	x		f_s		f_c		a		$\frac{f_c x a}{2}$		$\frac{f_c(b-a)}{2}$	
						ASCE	PS	ASCE	PS	ASCE	PS	ASCE	PS	ASCE	PS	ASCE	PS
1°	60	11120	24350	26° 55′	100	2.32	2.38	5310	8200	12830	16930	1.72	1.69	4740	6690	26040	28580
					85	2.03	2.10	5710	8180	14150	17690	1.49	1.47	4260	6000	26100	27900
	70	12830	23200	33° 33′	100	3.21	3.27	7010	11300	14650	18040	2.02	1.96	8000	10520	27340	29860
					85	2.84	2.90	8530	11370	15870	19330	1.80	1.70	7700	9830	27040	29170
2°	60	11160	24600	26° 53′	100	2.32	2.39	5430	8310	13070	17000	1.89	1.83	4590	6700	26360	28670
					85	2.03	2.10	5720	8180	14180	17690	1.69	1.60	4260	6000	26230	27970
	70	14340	24900	37° 25′	100	3.80	3.85	10210	14800	17090	22300	2.15	1.96	11000	14300	30760	33700
					85	3.37	3.42	11050	14700	18650	23240	1.93	1.79	10600	13150	30490	32890
3°	60	11200	24700	26° 56′	100	2.32	2.39	5450	8330	13410	17050	1.82	1.76	4610	6700	26625	28870
					85	2.04	2.11	5760	8270	14240	17770	1.50	1.47	4310	6080	26320	28084
	70	16360	26000	38° 55′	100	4.04	4.09	11360	15850	18400	23900	2.20	2.00	12480	15800	32730	36050
					85	3.59	3.64	12230	16310	20130	25095	1.97	1.82	12050	14830	32300	35100
4°	40	11140	28300	28° 10′	100	1.86	1.94	4370	6920	13310	17400	1.40	1.42	2810	4920	26828	30050
					85	1.62	1.70	4390	6780	14410	18030	1.21	1.26	2660	4290	28670	30300
	50	11180	26500	26° 54′	100	2.07	2.14	4870	7550	13290	17150	1.55	1.59	3780	5720	27810	29900
					85	1.81	1.88	5080	7500	14340	17880	1.36	1.37	3480	5130	27510	29160
	60	16850	28500	36° 16′	100	2.62	2.67	11110	13650	19080	25000	2.12	1.92	11750	13050	34700	38000
					85	3.21	3.26	12020	16040	20980	25960	1.90	1.77	11400	14170	34350	37120
	70	21380	21400	30200	45° 08′	100	5.16	5.19	16320	21400	23760	30900	2.34	2.10	19150	23300	40350	44860
					85	4.59	4.63	16970	23180	24830	32420	2.10	1.83	17850	22350	39250	43930
5°	40	11170	28300	28° 10′	100	1.87	1.94	4330	6930	13360	17350	1.41	1.43	3040	4940	26998	30190
					85	1.64	1.70	4520	6800	14540	18000	1.23	1.26	2760	4300	28834	30570
	50	24492	25362	34650	27° 10′	100	2.83	2.92	6180	9280	14080	19050	1.70	1.64	5250	7800	29180	32540
					85	2.06	2.13	6320	9330	15294	19890	1.52	1.47	4910	6860	29358	31300
6°	40	26080	11200	28400	23° 13′	100	1.87	1.94	4320	6950	13400	17380	1.40	1.43	3030	4970	29110	31050
					85	1.63	1.70	4470	6810	14539	18090	1.22	1.26	2750	4310	28810	30394
	50	25260	15320	29530	31° 15′	100	2.89	2.95	8660	12850	17640	22250	1.92	1.80	8540	11540	35800	38600
					85	2.55	2.61	9350	13040	18270	23060	1.72	1.63	8190	10630	35450	37900
7°	40	26150	11300	28500	23° 22′	100	1.88	1.96	4380	7060	13460	17320	1.41	1.44	3100	5080	29350	31850
					85	1.64	1.72	4530	6960	14590	18260	1.23	1.28	2730	4440	28880	30550
	50	26200	18850	31000	33° 43′	100	3.54	3.60	12880	17400	21410	27300	2.10	1.92	12850	16700	39050	42900
					85	3.14	3.18	13300	17780	23400	29110	1.86	1.76	12500	15600	38700	41000

At Outer Wheel of Guiding Truck: V	H	R	θ	Width of Section	x		f_s		f_c		a		$\frac{f_c x a}{2}$		$\frac{f_c(b-a)}{2}$	
					ASCE	PS	ASCE	PS	ASCE	PS	ASCE	PS	ASCE	PS	ASCE	PS
12800	9520	15950	36° 37′	100	3.67	3.73	6300	8900	10760	14040	2.12	1.94	6580	8630	19380	21430
				85	3.26	3.31	6860	9130	11780	14670	1.91	1.77	6550	8100	19350	20900
13200	9420	16200	35° 30′	100	3.51	3.56	6120	8640	10700	13910	2.09	1.92	6400	8390	19603	21400
				85	3.10	3.16	6590	8850	11670	14550	1.87	1.73	6160	7750	19360	20958
12900	9520	16050	36° 26′	100	3.64	3.70	6280	8870	10780	14040	2.14	1.96	6710	8600	19610	21300
				85	3.23	3.29	6820	9110	11780	14680	1.90	1.71	6500	8060	19400	20950
13700	9320	16350	34° 13′	100	3.31	3.37	5960	8330	10680	13800	2.04	1.88	5990	7930	19680	21350
				85	2.93	2.99	6320	8540	11600	14460	1.83	1.72	5780	7350	19400	21050
13000	9500	16100	36° 16′	100	3.60	3.64	6240	8810	10780	14020	2.11	1.83	6600	8300	19603	21300
				85	3.19	3.24	6750	8990	11750	14610	1.78	1.68	6400	7910	19400	20810
14230	9220	16950	32° 55′	100	3.12	3.18	5560	8030	10550	13700	1.89	1.85	5560	7410	19290	20940
				85	2.76	2.82	6030	8190	11510	14330	1.78	1.68	5380	6880	19040	21110
13050	9470	16100	35° 57′	100	3.57	3.62	6190	8780	10730	13950	2.10	1.92	6500	8370	19535	21420
				85	3.16	3.22	6680	8960	11720	14600	1.83	1.76	6300	7890	19350	20940
13100	9480	16170	35° 52′	100	3.56	3.62	6210	8750	10730	14000	2.11	1.92	6560	8400	19660	21300
				85	3.15	3.21	6680	8970	11720	14650	1.88	1.76	6300	7890	19400	20940
13900	9350	16750	33° 54′	100	3.27	3.32	5830	8290	10670	13850	2.03	1.87	5920	7760	19820	21460
				85	2.89	2.95	6280	8500	11640	14500	1.82	1.71	5720	7260	19620	21160
15480	8930	17850	29° 59′	100	2.72	2.78	4960	7250	10340	13450	1.66	1.75	4610	6340	20090	21830
				85	2.39	2.46	5270	7330	11230	14030	1.66	1.59	4370	5820	19850	21300
13120	9420	16150	35° 40′	100	3.52	3.58	6100	8660	10660	13900	2.09	1.82	6380	8310	19300	21430
				85	3.12	3.18	6610	8870	11670	14530	1.88	1.76	6230	7800	19350	20920
13500	9370	16400	34° 46′	100	3.33	3.43	5980	8480	10660	13900	2.06	1.90	6140	8050	19660	21395
				85	3.00	3.06	6440	8680	11640	14520	1.88	1.73	5960	7510	19460	21010
13200	9400	16200	35° 27′	100	3.49	3.55	6070	8670	10630	13900	2.09	1.91	6350	8250	19550	21430
				85	3.09	3.15	6560	8830	11640	14538	1.87	1.75	6140	7720	19340	20920
14200	9200	16900	32° 35′	100	3.18	3.18	5580	8010	10520	13700	2.08	1.84	5870	7300	19770	21390
				85	2.76	2.82	6010	8130	11490	14290	1.78	1.68	5350	6850	19550	20750
13270	9370	16250	35° 13′	100	3.46	3.51	6030	8530	10650	13850	2.06	1.81	6270	8150	19540	21430
				85	3.06	3.12	6500	8750	11620	14490	1.86	1.74	6050	7610	19320	20890
15000	8890	17450	30° 39′	100	2.81	2.87	5040	7330	10260	13320	1.90	1.77	4760	6490	19700	21490
				85	2.47	2.54	5390	7450	11170	13930	1.69	1.61	4550	6000	19550	21000

TABLE III.—CLASS B LOCOMOTIVE.

Degree of Curve	Speed in Miles per Hour	At Outer Wheel of Front Drivers: V	H	R	θ	Width of Section	x		f_s		f_c		a		$\frac{f_c x a}{2}$		$\frac{f_c(b-a)}{2}$	
							ASCE	PS	ASCE	PS	ASCE	PS	ASCE	PS	ASCE	PS	ASCE	PS
1°	60	21260	11500	24200	28° 22′	100	2.51	2.57	5930	8850	13390	17400	1.78	1.68	5320	7460	26580	28720
						85	2.20	2.27	6340	8840	14720	18110	1.57	1.53	4980	6860	26390	28100
	70	18820	12950	22850	34° 32′	100	3.36	3.42	8200	11680	14740	19200	2.06	1.89	6330	11050	27150	29870
						85	2.97	3.03	8850	12340	16080	20940	1.84	1.72	8150	10300	26870	29120
2°	60	21340	11520	24250	28° 22′	100	2.51	2.57	6020	8880	13440	17450	1.78	1.69	5360	7500	26700	28860
						85	2.20	2.27	6380	8830	14600	18210	1.58	1.53	5050	6880	26390	28320
	70	19110	14380	23900	36° 57′	100	3.72	3.78	9580	13328	16220	21150	2.14	1.95	10230	13200	29340	32310
						85	3.30	3.36	10400	13870	17760	22130	1.92	1.78	9880	12350	29090	31460
3°	60	21410	11670	24358	28° 22′	100	2.51	2.57	6050	8910	13490	17500	1.78	1.68	5380	7510	26700	28820
						85	2.20	2.27	6370	9010	14630	18250	1.58	1.53	5010	6880	26620	28280
	70	19570	15870	25260	39° 03′	100	4.06	4.11	11020	15400	17820	23200	2.20	2.00	12100	15360	31670	34830
						85	3.60	3.65	11340	15820	19480	24280	1.97	1.82	11760	14450	31330	34020
4°	40	25320	11550	27900	24° 32′	100	2.03	2.10	4950	7700	13750	17850	1.52	1.51	3760	5810	29080	31130
						85	1.77	1.84	5120	7610	14880	18550	1.33	1.34	3400	5120	28720	30440
	50	23410	11580	26100	26° 17′	100	2.84	2.31	5460	8320	13600	17650	1.69	1.60	4510	6630	27920	30040
						85	1.96	2.03	5740	8280	14760	18400	1.45	1.44	4160	5850	27570	29360
	60	22200	14320	26400	32° 49′	100	3.11	3.17	8680	12440	16400	21300	1.99	1.84	8650	11470	30850	33670
						85	2.74	2.81	9280	12700	17820	23300	1.76	1.66	10160	10350	30350	32860
	70	20130	20200	28500	45° 05′	100	5.16	5.20	15290	21100	22290	29200	2.34	2.02	17900	21300	38030	44430
						85	4.60	4.64	16020	21900	24580	30600	2.10	1.93	17700	21100	37830	41230
5°	40	25320	11550	27900	24° 32′	100	2.03	2.10	4950	7700	13750	17850	1.52	1.51	3760	5810	29080	31130
						85	1.77	1.84	5120	7610	14950	18550	1.33	1.34	3400	5120	28770	30440
	50	23660	12300	26650	27° 26′	100	2.38	2.45	6110	9180	14350	18650	1.71	1.65	5230	7570	28890	31230
						85	2.09	2.16	6430	9240	15010	19400	1.52	1.49	4940	6880	28600	30540
6°	40	25370	11600	27900	24° 34′	100	2.03	2.10	4940	7710	13760	17860	1.52	1.51	3760	5800	29130	31170
						85	1.77	1.84	5110	7630	14930	18580	1.32	1.34	3390	5130	28760	30380
	50	24480	15080	28700	31° 35′	100	2.94	3.00	8840	12760	17350	22500	1.94	1.81	8580	11520	33060	36900
						85	2.59	2.65	9440	12910	18280	23490	1.73	1.64	8170	10600	32650	35980
7°	40	25440	11600	27950	24° 38′	100	2.02	2.09	4920	7690	13760	17850	1.52	1.50	3730	5790	29170	31230
						85	1.76	1.83	5100	7570	14930	18570	1.32	1.34	3380	5070	28820	30510
	50	25260	18150	31100	35° 41′	100	3.53	3.58	11810	16700	20590	26800	2.10	1.92	12370	16020	37630	41200
						85	3.13	3.18	12240	17070	22450	27990	1.75	1.76	10700	14250	35960	40016

At Outer Wheel of Guiding Truck: V	H	R	θ	Width of Section	x		f_s		f_c		a		$\frac{f_c x a}{2}$		$\frac{f_c(b-a)}{2}$	
					ASCE	PS	ASCE	PS	ASCE	PS	ASCE	PS	ASCE	PS	ASCE	PS
8440	5970	10350	35° 17′	100	1.47	1.53	3650	5470	6790	8850	2.08	1.81	4690	5830	12440	13670
				85	1.30	1.36	4150	5590	7610	9230	1.86	1.76	3870	4890	12310	13310
8680	5960	10520	34° 29′	100	1.33	1.41	3770	5370	6790	8850	2.06	1.89	3870	5070	12550	13750
				85	1.18	1.25	4260	5470	7600	9230	1.84	1.72	3710	4700	12410	13380
8500	5970	10380	35° 05′	100	1.44	1.50	3630	5450	6780	8850	2.07	1.90	3960	5200	12460	13700
				85	1.28	1.33	4150	5550	7630	9230	1.86	1.74	3860	4830	12360	13390
8960	5920	10740	33° 25′	100	1.20	1.26	3640	5222	6760	8800	2.01	1.84	3860	4860	12820	13820
				85	1.06	1.12	4260	5470	7600	9230	1.84	1.72	3710	4700	12410	13380
8520	5980	10410	35° 05′	100	1.44	1.50	3840	5450	6800	8840	2.07	1.90	3970	5190	12490	13710
				85	1.30	1.36	4150	5570	7630	9230	1.86	1.88	3860	5250	12360	13720
9230	5880	10958	32° 36′	100	1.06	1.12	3520	5062	6740	8780	1.97	1.83	3480	4630	12710	13860
				85	0.94	0.99	4270	5150	7540	8180	1.76	1.67	3340	4300	12570	13530
8500	5940	10370	34° 57′	100	1.42	1.48	3800	5400	6760	8810	2.07	1.90	3940	5130	12440	13630
				85	1.03	1.09	4110	5520	7590	9200	1.86	1.74	3810	4790	12310	13290
8550	5950	10410	34° 50′	100	1.40	1.46	3790	5380	6770	8800	2.07	1.90	3820	5100	12470	13650
				85	1.01	1.07	4090	5510	7590	9210	1.85	1.73	3780	4760	12340	13310
9020	5920	10800	33° 17′	100	1.22	1.29	3700	5320	6840	8910	2.02	1.87	3740	4970	12760	13990
				85	1.05	1.11	3930	5410	7670	9310	1.80	1.72	3600	4600	12620	13620
9920	5800	11500	30° 17′	100	1.26	1.32	3240	4720	6680	8700	1.88	1.76	3040	4160	12960	14080
				85	1.03	1.09	3460	4820	7280	9100	1.67	1.66	2890	3870	12610	13780
8440	5940	10460	34° 43′	100	1.38	1.44	3760	5360	6790	8860	2.06	1.90	3870	5080	12490	13630
				85	1.00	1.05	4080	5480	7380	9140	1.85	1.73	3780	4740	12360	13310
8700	5940	10520	34° 20′	100	1.33	1.39	3750	5356	6770	8830	2.05	1.88	3650	5060	12620	13750
				85	1.95	1.00	4050	5450	7380	9210	1.84	1.72	3720	4690	12440	13390
8600	5940	10450	34° 36′	100	1.37	1.43	3760	5380	6760	8810	2.04	1.89	3870	5060	12470	13660
				85	1.98	1.04	4060	5480	7380	9200	1.84	1.72	3740	4730	12340	13330
9200	5900	10920	32° 40′	100	1.08	1.15	3560	5110	6760	8800	1.98	1.84	3540	4700	12740	13900
				85	1.72	1.79	3810	5210	7350	9180	1.77	1.67	3370	4360	12570	13560
8650	5900	10470	34° 18′	100	1.32	1.38	3710	5290	6710	8760	2.05	1.88	3800	4980	12450	13630
				85	1.24	1.30	3990	5410	7350	9150	1.82	1.72	3640	4650	12280	13300
9700	5840	11310	31° 03′	100	1.26	1.32	3350	4850	6730	8730	1.91	1.78	3200	4330	12900	14030
				85	1.12	1.18	3580	4930	7310	9110	1.71	1.62	3060	4000	12760	13700

TABLE IV.—CLASS C LOCOMOTIVE.

Degree of Curve	Speed in Miles per Hour	At Outer Wheel of Front Drivers: V	H	R	θ	Width of Section	x		f_s		f_c		a		$\frac{f_c x a}{2}$		$\frac{f_c(b-a)}{2}$	
							ASCE	PS	ASCE	PS	ASCE	PS	ASCE	PS	ASCE	PS	ASCE	PS
1°	60	15480	13180	20600	40° 24′	100	4.29	4.34	9360	13050	14740	19250	2.24	2.02	10480	13180	25960	28660
						85	3.81	3.86	10180	13420	16140	20120	2.00	1.85	10200	12410	25580	27890
	70	10710	14700	18200	53° 55′	100	7.28	7.30	12300	16610	16020	20900	2.50	2.22	15370	18400	26500	29110
						85	6.61	6.64	13490	17310	17610	21920	2.26	2.04	15200	17650	25916	28360
2°	60	15500	13250	20400	40° 32′	100	4.31	4.36	9460	13120	14940	19300	2.24	2.02	10600	13270	26100	28770
						85	3.83	3.88	10270	13530	16230	20230	2.01	1.86	10330	12550	25930	28050
	70	10910	14700	20500	57° 54′	100	8.51	8.58	15100	20250	18900	24300	2.55	2.27	19250	23000	30460	33910
						85	7.68	7.69	16600	21190	20800	25810	2.30	2.08	19100	22000	30005	32910
3°	60	15580	13600	20700	41° 07′	100	4.42	4.46	9790	13550	15210	19800	2.25	2.03	11000	13750	26580	29330
						85	3.93	3.97	10680	13980	16680	20720	2.06	1.86	10800	13030	26380	29060
	70	11160	19400	22350	60° 06′	100	5.40	5.40	17110	23000	20980	27300	2.28	2.29	22400	26200	33260	37360
						85	8.43	8.43	18650	23950	23150	28800	2.33	2.10	21958	25200	33110	36960
4°	40	23110	13050	26550	28° 26′	100	2.66	2.71	7100	10400	16460	19650	1.84	1.73	6580	8900	29650	32110
						85	2.32	2.39	7510	10500	16910	20300	1.63	1.57	5780	8040	29380	31350
	50	19660	13300	23750	34° 06′	100	3.29	3.35	9330	11880	16170	19750	2.04	1.88	8500	11150	28160	30610
						85	2.91	2.97	8990	12150	16510	20650	1.82	1.72	10420	27870	30080	
	60	16110	17750	23280	47° 44′	100	4.72	5.76	13950	19050	19550	25500	2.40	2.14	16700	20360	32810	36410
						85	5.11	5.10	15250	19780	21450	26680	2.16	1.96	16420	19370	32536	35480
	70	11740	25800	28520	65° 32′	100	7.02	7.09	23560	31400	27640	36150	2.65	2.32	31200	36400	42940	48140
						85	9.80	9.76	26940	32660	30440	37840	2.38	2.15	31000	35250	42740	46920
5°	40	23110	13100	26600	28° 35′	100	2.66	2.72	7130	10450	15170	19700	1.84	1.73	6560	9060	29670	32170
						85	2.34	2.41	7630	10650	16530	20650	1.64	1.58	6260	8390	29370	31500
	50	19900	14500	24600	36° 05′	100	3.58	3.64	9880	13420	16400	21400	2.10	1.93	10000	12900	29000	32000
						85	3.18	3.23	10290	13750	17930	23350	1.89	1.76	9730	12100	29636	32000
6°	40	23190	13400	26800	28° 00′	100	2.72	2.78	7420	10850	15480	20140	1.86	1.75	6922	9500	30110	32690
						85	2.33	2.38	7890	10920	16880	20760	1.66	1.59	6540	8740	29730	31930
	50	20570	18400	27100	40° 50′	100	4.51	4.59	13420	18550	20580	26800	2.27	2.05	15250	19000	35830	39570
						85	4.00	4.09	14390	19150	22570	28030	2.04	1.78	14800	17030	35460	37620
7°	40	23230	13500	26900	30° 07′	100	2.74	2.80	7510	10960	15590	20250	1.87	1.76	7030	9610	30260	32860
						85	2.41	2.47	8050	11080	16840	21120	1.67	1.59	6720	8810	29935	32040
	50	21340	23500	29200	46° 31′	100	5.48	5.52	17460	23600	24080	32650	2.32	2.12	20700	25300	41900	46500
						85	4.89	4.92	18110	24170	27280	33920	2.14	1.87	20400	24200	41600	45940

At Outer Wheel of Guiding Truck: V	H	R	θ	Width of Section	x		f_s		f_c		a		$\frac{f_c x a}{2}$		$\frac{f_c(b-a)}{2}$	
					ASCE	PS	ASCE	PS	ASCE	PS	ASCE	PS	ASCE	PS	ASCE	PS
14400	6900	15950	25° 34′	100	2.15	2.22	3120	4780	8140	10540	1.58	1.56	2490	3730	16890	18130
				85	1.88	1.94	3270	4810	8810	11030	1.40	1.40	2300	3380	16700	17780
14800	6910	16300	24° 39′	100	2.08	2.15	3010	4680	8150	10600	1.55	1.53	2330	3580	17130	18360
				85	1.82	1.89	3170	4660	8870	11060	1.30	1.37	2160	3190	16960	17990
14550	6900	16100	25° 22′	100	2.13	2.20	3100	4720	8160	10600	1.58	1.54	2460	3640	17010	18190
				85	1.86	1.93	3230	4740	8830	11020	1.39	1.39	2240	3300	16790	17850
15150	6910	16650	24° 25′	100	2.02	2.09	2910	4580	8190	10630	1.52	1.48	2200	3400	17350	18530
				85	1.76	1.83	3020	4510	8860	11058	1.32	1.34	1990	3020	17140	18170
14700	6900	16250	25° 08′	100	2.10	2.17	3050	4700	8150	10580	1.56	1.54	2390	3620	17090	18330

Yellow Pine (long leaf), 5,000 lbs.—Values recommended by A. L. Johnson.

Yellow Pine (long leaf), 4,800 lbs.—Average of tests, Table 12, Circular 115, Forestry Service.

If, now, the values obtained from the tests on very small and well-seasoned specimens are not considered, since they are much higher than any occurring under the conditions in actual practice, 3,500 lbs. per sq. in. may be taken as a fair value for the ultimate crushing strength of beech, cedar, chestnut and white oak, and 4,500 lbs. as a fair value for yellow pine.

It is difficult to arrive at a fair value to take for the crushing strength of catalpa, as but a very few tests seem to have been made, and no description of tests or data as to their reliability is available. Until more definite information is obtained, 2,500 lbs. per sq. in. will be taken as the value for the ultimate crushing strength of catalpa. It has just been demonstrated that before a spike will fail by shearing, a crushing stress of 12,800 lbs. per sq. in. is exerted on wood back of spike, and it has now been shown that the resistance of the wood to crushing, in the hardest wood ties, is only 4,500 lbs. It is, therefore, concluded that the wood in a tie back of spike will crush before the spike will shear off.

It is now required to determine the number of spikes necessary to use in the various wood ties. Turning back to Table I., it is seen that the maximum horizontal force acting at one tie is 8,800 lbs. This, however, is the force exerted by a Class C freight engine on a 4-degree curve, and running at a speed of 70 miles per hour. This speed would probably never be attained with this engine on a 4° curve. It is thought that a horizontal force of 4,000 lbs. at one tie will very nearly represent what is likely to occur in actual practice, and this value has been used here in determining the number of spikes necessary to use. It is approximately the value given in Table I. for both Class A and B locomotives on a 3° curve, and at a speed of 70 miles per hour. The number of spikes required in the different wood ties, to resist crushing of wood back of spike and shearing off of spike, will now be given for the case where flat tie plates are used and for the case where Goldie claw plates are used. [See footnote on p. 504. The numbers of spikes given in the table should be doubled.—Ed.]

KIND OF WOOD.	Using Flat Tie Plates				Using Goldie Tie Plates.			
	No. Required to Resist Crushing of Wood		No. Required to Resist Shearing of Spike.		No. Required to Resist Crushing of Wood.		No. Required to Resist Shearing of Spike.	
	No Factor of Safety	Factor of Safety 4	No Factor of Safety.	Factor of Safety 4	No Factor of Safety.	Factor of Safety 4	No Factor of Safety.	Factor of Safety 4
Catalpa	2	5	1	1	0	2	0	1
Beech, Cedar, Chestnut and White Oak	1	3	1	1	0	1	0	1
Yellow Pine	1	3	1	1	0	1	0	1

The results given in the above table are the total number of spikes necessary in each tie at the outer rail, for when tie plates with shoulders are used the spikes on both outer and inner side of rail may be considered as brought into action. At first the spikes on outer side of rail may get all the thrust, on account of holes in tie plates being slightly larger than spikes, but before this thrust is large enough to shear the outer spikes the wood will crush a little and allow spikes on outer side of rail, together with tie plate, to move out slightly until tie plate bears against spikes on inner side of rail. These spikes will now be brought into action and relieve load on outer spikes.

In computing the number of spikes necessary for the case where Goldie claw plates are used it was assumed that the four claws of the plate were entirely imbedded in sound wood and that their entire surface area of 3.5 sq. ins. was bearing against wood. Whether this actually occurs is questionable, for the fact that the claws must be driven into the wood may, by bruising the fibers, cause decay to take place around the claws much faster than elsewhere. Of course, driving spikes into the tie will also injure fibers of wood, but whether the injury done by spike is as harmful as injury done by claws is uncertain. In the case of a treated tie, the use of a Goldie claw plate or of a driven spike tends to defeat the purpose of treatment, on account of tearing the fibers of the wood and exposing them to action of weather.

CONCLUSIONS.

The conclusions arrived at from this study are:

(1) The horizontal forces exerted upon rail and stresses produced in track fastenings by a Class A locomotive in rounding curves are but very little greater than those obtained by a Class B locomotive.

(2) The horizontal forces exerted and stresses produced in track by a Class C locomotive are approximately 20% larger than those obtained from either a Class A or Class B locomotive.

(3) At same speeds on same curve, at outer wheel of front drivers, the resultant is farthest beyond the center of base of rail in this order: Class C, Class B, Class A.

At the outer wheel of guiding truck this order is exactly reversed: Class A, Class B, Class C. Class B and Class A are very nearly alike.

(4) If Class B and Class A are run around curves up to 3° at 60 miles per hour, the Class C should not be run around any curve faster than 40 miles per hour, in order not to have the distance of the resultant force from center of base of rail exceed that given by the first two locomotives.

(5) The maximum shear on the fastenings in a tie, in nearly every case, is produced by a Class A locomotive when the centrifugal force is balanced, and by a Class C when the speed exceeds that for which the outer rail was superelevated.

(6) The horizontal forces at the head of the rail and the resultant of the horizontal and vertical forces at the same point are greater at the outer wheel of front driver than at the outer front wheel of the guiding truck for all three locomotives.

(7) The horizontal forces exerted and stresses produced at the outer front wheel of the guiding truck of a Class A locomotive are about 50% larger than those produced by a Class B, and about 35% larger than for a Class C.

(8) In nearly every case the horizontal force exerted at the outer front wheel of guiding truck decreases very slightly as the speed and curvature increase, but the opposite is true in the case of the outer wheel of the forward driver.

(9) In every case the resultant force acting on the rail at the outer wheel of the guiding truck increases with increase of speed and curvature.

(10) At outer wheel of front driver for Class A, Class B, and nearly for Class C, resultant force and position at base of rail are the same at 60 miles per hour for 3° and under, centrifugal force balanced.

Resultant force and position at base of rail are the same at 40 miles per hour for 4°, 5°, 6° and 7°, centrifugal force balanced.

The above two do not hold for unbalanced speeds.

(11) In many cases on curves the resultant force acting on rail passes entirely outside of base of rail. At the guiding truck of Class A and Class B, this happens in nearly every case. It also occurs at the outer wheel of front driver for all three locomotives, in the cases of greatest curvature and speed.

(12) At guiding truck for Class A and Class B the resultant falls outside of base of rail in all cases but two for A. S. C. E. rail and in all cases for Pennsylvania System rail; but for the Class C it falls inside in all cases.

At the outer wheel of front driver for Class A and Class B the resultant falls within the base of rail for speeds up to about 60 miles per hour on curves up to 3°; up to about 50 miles per hour for 4° and 5° curves, and up to 40 miles per hour on 6° and 7° curves.

(13) In all kinds of wood ties [illegible] Class C only for speeds up to 40 miles per [illegible] wood back of a spike will crush before a s[illegible]nt force can be exerted on an ordinary 5/8 [illegible]ike to shear it off.

(14) The present practice of p[illegible]g two spikes on inside and one on outside [illegible]e outer rail on curves, when flat tie plates [illegible] used, gives ample strength against shear[illegible] spike and just sufficient strength against [illegible]ing of wood back of spikes, except when [illegible] ties are used. With Goldie plates the [illegible]gin is much larger.

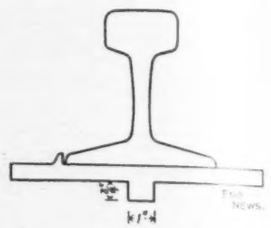


Fig. 5.

(15) The present method of fastening rails to wood ties is rather weak with regard to liability of crushing wood back of fastenings.

It is suggested that an improvement might be made over our present method of fastening track by using a special tie plate under the outside rail on curves, this tie plate to have a lug or projection on the under side, 1 in. wide, and from ¾ to 1 in. in depth, as shown in Fig. 5. The slot in tie, which receives the lug, should be cut out by machine to insure an even bearing on sides, and in cases where treated ties are used should be made before tie is treated. The tie should be slotted for outer rail only, an ordinary flat plate being used under inner rail.

In considering the results obtained from the computations in this study, the fact must not be lost sight of that the same degree of accuracy cannot be expected here, as is obtained in most other calculations of stresses. There are many assumptions which have to be made, and many other things, such as irregularities in alinement and surface of track, sudden application and removal of load, etc., which may modify and change the results obtained by any computation from the actual results. Up to the present time, practically no experimental data of any value, with regard to the stress in track fastenings on curves, are available, and experiments along this line are needed.

ADDENDA, BY W. C. CUSHING.

In 1907, the Pennsylvania Railroad Company prepared a piece of track on the West Jersey & Seashore Railroad, on a one-degree curve, near Franklinville, N. J., with special cast steel ties and measuring apparatus for the purpose of comparing the effects of lateral horizontal forces on the outer rail of the curve generated by different classes of electric locomotives and standard steam locomotives.

The force exerted by the locomotive was communicated to steel plates by means of hardened steel spheres of small diameter, and the effect of the force was to cause the spheres to make a more or less deep impression in the steel plates.

By means of laboratory tests, it was determined what forces in pounds were required to produce various known depths of the impression of the steel balls in the plates, and after this calibration had been made, it was possible to transform the depths of the impression of the balls in the plates into pounds of pressure. The accompanying Table No. 1 gives the results of some of these tests for steam locomotives, in order that they may be compared with the computations made by Mr. Stetson, which are shown in Table No. 2 for the same degree of curve, and for one locomotive of the same class as used in the tests on the Atlantic City line. Mr. Stetson's calculations are for speeds of 60 miles per hour, which are from 20 to 30 miles an hour less than the actual tests, but the weights of the locomotives are heavier. The lower speeds should give smaller pressure, while, on the other hand, the heavier locomotives should give higher pressures. Taking these points into consideration, therefore, the difference between the two tables is not large, indicating that the formulas used by Mr. Stetson are fairly correct in these comparisons.

HORIZONTAL PRESSURES EXERTED BY STEAM LOCOMOTIVES AGAINST RAIL ON CURVES.

TABLE NO. 1.—Results of Tests Made in 1907 at Franklinville, N. J., on West Jersey & Sea Shore R. R. on a 1% Curve.

Run No.	Speed in Miles Per Hour.	Speed Corresponding to Superelevation.	Type of Locomotive	Condition of Rail.	Maximum Depth of Impression.	Maximum Pressure in Lbs.
9	80 4	70	B	Dry	0 204 in.	10,500
10	82 7	70	B	Dry	0 246 in.	13,000
17	82 3	70	B	Dry	0 223 in.	11,500
18	90 5	70	B	Dry	0 216 in.	11,300
19	85 03	70	B	Dry	0 199 in.	10,300
20	79 50	70	B	Dry	0 193 in.	10,100
21	75 5	70	B	Wet	0 162 in.	8,300
22	80 7	70	B	Wet	0 217 in.	11,200
23	81 29	70	B	Wet	0 217 in.	11,200
111	85 30	70	B	Dry	0 179 in.	9,500
118	80 3	70	B	Wet	0 181 in.	9,500
119	83 9	70	B	Wet	0 189 in.	10,000
120	82 9	70	B	Wet	0 199 in.	10,300
11	81 3	70	D	Dry	0 165 in.	8,700
12	83 5	70	D	Dry	0 134 in.	7,000

Class B is an Atlantic type locomotive, total weight = 170,000 lbs., height center of gravity above base = 73 in.
Class D is an American type locomotive, total weight = 138,000 lbs., height center of gravity above base = 66 in.

TABLE NO. 2.—Results of Computations made by E. E. Stetson for a 1% Curve.

Speed in Miles Per Hour.	Speed Corresponding to Superelevation.	Type of Locomotive.	Pressure in Lbs.	Remarks.
60 70	60 60	Class B Class D	11,500 12,900	Class B is an Atlantic type, total wt.=189,180 lbs., ht. c. g. above rail taken as 70.5
60 70	60 60	Class A Class A	11,120 12,820	Class A is Pacific type, total wt. 270,100 lbs., ht. c. g. above rail = 79.25
60 70	60 60	Class C Class C	13,180 14,700	Class C is Consolidation type, total wt. 238,200 lbs., ht. c. g. above rail = 62.

ANNUAL MEETING OF THE SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS.

The sixteenth general meeting of the Society of Naval Architects and Marine Engineers was held in New York City at the Engineering Societies Building on Nov. 19 and 20. On the evening of the second day the annual banquet was held at Delmonico's. This was the single social event of the convention. Brief mention of the principal papers presented is given below.

Mr. F. L. Fernald, Naval Constructor, U. S. N., Elliot, Me.; Mr. Stevenson Taylor, Quintard Iron Works, New York City, Mr. W. M. McFarland, Westinghouse Electric & Manufacturing Co., Pittsburg, were elected Vice-Presidents. Ten members of the Council of the Society were also elected. All other officers were retained by virtue of unexpired terms.

HISTORICAL AND DESCRIPTIVE PAPERS.—The "War Eagle" was the name of a famous fast sailing vessel of the "Baltimore clipper" type designed by Mr. Wm. Cramp and his son, Mr. Charles H. Cramp. The latter was the author of a paper bearing this title. He told, in pleasing reminiscent style, the history of this craft—the fastest boat of its day, whose type has given the design of "cup-defenders."

In "The Oldest Iron Ship in the World," Mr. Henry Penton, of Cleveland, O., described the only war vessel on the Great Lakes. This boat was built 66 years ago and is the veteran in active service of the navy. It is also the first iron warship ever built.

"The British International Trophy Race of 1908" was the title of a paper by Mr. W. P. Stevens, of Bayonne, N. J., editor of Lloyds Register of American Yachts. Mr. Stevens traced the history of the Harmsworth Trophy and described the designing and the trials of the "Dixie II.," the winner of the 1908 race. This boat is 39 ft. 3 ins. long over all, has a displacement, in racing trim, of 4,500 lbs. and is equipped with a single 200-HP. engine. The boat has a record of 35.75 statue mi. per hr. It was designed by Mr. C. H. Crane, of Messrs. Tams, Lemoine & Crane, New York City, the builders.

Mr. Robert Curr, Naval Architect of Cleveland, O., in "Shipbuilding on the Great Lakes," traced shipyard practice of this region through the numerous processes of building a modern lake vessel of the hopper type. The ordering of material and handling of parts were carefully described.

"The Steamer 'Commonwealth,'" by Mr. W. T. Berry, General Superintendent of the Quintard Iron Works, New York City, and Mr. J. H. Gardner, Superintendent of Marine Construction of the New England Steamship Co., Newport, R. I., described the construction and fittings of this passenger steamer which was built for night service between New York City and Fall River, Mass. This boat has side paddle wheels driven by a double, compound inclined, reciprocating engine of 10,000 I. HP., with two high-pressure cylinders of 50-in. diameter and two low-pressure cylinders of 96-in. diameter. Steam is supplied by ten Scotch boilers, five on each side of a fore-and-aft center firing floor.

Particular attention has been paid to the fire-protection appliances and it is interesting to quote from the paper concerning these arrangements.

> All wood work throughout the cargo space, emigrant quarters, crew's quarters on the main deck, and kitchen on the dome deck, is covered with galvanized iron, fastened directly to the wood. Steel decks are fitted over the boiler compartment, coal bunkers and engine compartment. The engine-room and boiler-room ventilators and enclosures are of steel extending through top of dome.
>
> Two fire bulkheads are provided, extending from the main decks through all decks to the dome, dividing the vessel into three fire compartments. These bulkheads are of double thickness ¾-in. tongue and groove wood, cross-planked diagonally and lined on both sides with plaster board covered with galvanized iron. Suitable sliding doors are provided in the main corridors and freight space. An iron bulkhead extending entirely across the upper deck house, is fitted just forward of the kitchen range.
>
> There are 60 fire hydrants located throughout the steamer, connected by copper fire mains with the fire and wrecking pumps, a 50-ft. length of hose is coupled to each hydrant and the location is such that all portions of the steamer are protected. Portable hose are also carried by both engine and deck departments, and 37 fire extinguishers are located in convenient places.
>
> In addition to this an independent sprinkler system is provided, with 1,800 automatic heads, distributed throughout the interior of the steamer, staterooms, and lockers, not exceeding 8 ft. from center to center in any place. This system is divided into 30 circuits, each with a 4-in. diameter main from a manifold located in the engine-room on the main deck. To this manifold the main discharge from a 16 × 12 × 12-in. duplex sprinkler pump is connected. This pump at all times maintains a pressure at the manifold of 100 lbs. per sq. in. and is fitted with a governor to maintain this pressure in case of the opening of any of the circuits and sprinklers and is also fitted with a throttle by-pass which can be operated from the main engine-room.
>
> Supplementary to this system is a thermostat system with mercury thermostats located on not over 12-ft. centers with all wires run in conduit, and divided into circuits corresponding with the sprinkler circuits. This system terminates at two annunciators, one in the main saloon and one in the engine-room, indicating the circuit number. The opening of a valve of corresponding number on the sprinkler system manifold supplies water to the sprinklers at the fire.
>
> In addition to the two main annunciators on the thermostat system, small annunciators are located throughout the saloons to determine the location of a fire within a range of a few staterooms. All the annunciator drops, besides showing the circuit number, indicate the location on the steamer and ring 8-in. alarm bells located in the crew's quarters, engine-room and saloons. This whole system deviates to some extent from the systems in use on land. The wet-pipe system, where all the pipes are filled with water under pressure, was impossible because of the great weight and danger of freezing. The dry-pipe system (with pipes filled with air under pressure which when released operates an automatic valve admitting water to the system) was not used because of the possibility of flooding a section of the ship where the pipes might be damaged in case of collision.
>
> A watchman's time detector is connected with 38 recording stations so located that in order to make a proper record, the watchman must pass through every section of the ship.

Considerable space in this paper was devoted to the architectural and decorative feature of the boat. A noted departure from time-honored practice lay in placing the dining-room on the upper deck, greatly adding to the passengers' enjoyment. To support the added weight I-beam girders were run under the deck and the structure was supported by two lines of stanchions running through the main saloon. As a base of decorative treatment of this saloon, groined arches were fitted between stanchions. The quarter deck is finished in a modern English style with beautiful marquetry panels left in the library with Louis XVI. decorations. From the quarter deck the main stairway leads up to a saloon finished in the period of Louis XV. Forward of this is the main saloon with the ceiling of groined arches. This room has been treated in Venetian-Gothic style. In the forward end of this saloon is a large mural painting typifying the Commonwealth.

In the discussion of this paper, preliminary figures were presented of a trial trip made on Nov. 14 in Narragansett Bay. It was stated that the regular service of the boat had prevented earlier trials. Eleven runs over the measured course were made after the boat had discharged its cargo from a regular trip. The draft was found to be 13 ft., ½ in. and the trim, by stern, 12 ins. In maintaining a speed of 22 mi. per hr., 9,050 I. HP. was developed and at 16 mi. per hr. the figure was 3,100. The remarks of the various critics were extremely complimentary to Mr. Stevenson Taylor, who was largely responsible for the design and who was credited with great influence in the development of the present Sound and Hudson River boats.

The paper by C. C. West, of Manitowoc, Wis., on "Centrifugal Fire Boats," was presented by Mr. W. T. Babcock, of New York, the designer of the boats particularly described in the paper. These boats were built to fit the peculiar conditions of service in the Chicago River.

Mr. T. M. Cornbrooks of the Newport News Shipbuilding and Dry Dock Co., presented "Sea-Going Suction Dredges." This paper placed on record a small amount of data on the design and construction of the sea-going suction dredges contracted for by the Engineer Department, U. S. Army, during the past five years.

"Recent Inventions Applied to Modern Steamships" was the title of a paper by Mr. W. C. Wallace, of New York City, representing John Brown & Co., of England, the builders of the Cunarder "Lusitania." The mechanism described by Mr. Wallace were: (1) hydraulic bulkhead doors in the water-tight compartments of the "Lusitania;" (2) the compressed-air ash expelling which dump the ashes through the ship's bottom and shoots them clear of the hull; (3) an arrangement of cooling pipes for tropical boats; (4) a thermostat for vessels having staterooms electrically heated.

PAPERS ON DESIGN.—"The Influence of Midship-Section Shape Upon the Resistance of Ships." This paper by D. W. Taylor, Naval Constructor, U. S. N., Washington, D. C., takes up the effect of the shape of midship section only and does not deal with the effect of actual area. Mr. Taylor's conclusions are contrary to many designers' opinions, but are in accordance with many builders' experience. We quote his conclusions:

> A natural tendency is to associate fineness with speed and to suppose that a fine midship section is favorable to speed. The results of experiments with the 40 models laid before you in this paper show that, as regards these models, fineness of midship-section is by no means favorable to speed, and furnish a presumption that, for vessels generally of ordinary types, it is not favorable to speed. Of course it cannot be claimed that the 40 models tried cover the whole possible field.
>
> It seems reasonable to conclude, however, that the shape of the midship-section has a comparatively minor influence upon the speed, and that the midship-section coefficient [ratio of submerged midship-section area to area of a rectangle enclosing water line and bottom—Ed.] may range from 0.85 to 1.0 with very little effect upon speed and may be made as low as 0.70 without a material increase in resistance.
>
> A reasonable explanation of the results I have laid before you may be deduced. It is seen that the fine midship sections are associated with the large dimensions. This is necessarily the case when we separate the question of midship-section coefficient from the question of midship-section area. If area is constant, smaller coefficients must mean larger dimensions. Increased beam and draft mean increased disturbance of a portion of the water through which the ship passes.

Prof. H. C. Sadler, University of Michigan, presented a paper "Experiments on Logitudinal Distribution of Displacement and Its Effect on Resistance," representing a study along somewhat similar lines to that of Mr. Taylor. In the models, a parallel middle body was used with variation of full and fine ends. It was found, in brief, that a long parallel middle body with fine ends was more resistant to propulsion than a shorter middle body with fuller ends. The qualifications and causes were carefully outlined.

"Further Analysis of Propeller Experiments," was presented by Mr. C. H. Crane, of Messrs. Tams, Lemoine & Crane, New York City. This outlined a method by which, with accumulated data on propellers a designer could more accurately predetermine the performance of a new design or to fit a wheel, for a certain duty, to a particular engine requirement.

In "The Influence of Free Water Ballast Upon Ships and Floating Docks," Naval Constructor T. G. Roberts, U. S. N., of New York City, presented some notes covering the theory of the stability of floating docks throughout its varied operations. These covered such topics as (1) loss and gain of stability in ships due to free water ballast; (2) compensating for loss due to free-water surface; (3) free water in a side compartment; (4) stability and strength in floating docks; (5) towing and durability. The paper is a self-contained exposition of this side of floating-dock design.

PAPERS ON TRIALS AND OPERATION.—Col. E. A. Stevens, of New York City, in the paper, "Practical Methods of Conducting Trials of Vessels" contributed a few notes on some of the practical points of vessel trials—determining the number of revolutions, mean effective pressures, time, tidal currents, etc.

The paper "Service Test of The Steamship 'Harvard,'" by Prof. C. H. Peabody, Prof. W. S. Leland, and Mr. H. A. Everett, of The Massachusetts Institute of Technology, related the conditions and results of the engine and boiler

trials made on a regular service run of this boat between New York and Fall River. The coal was measured by buckets; the water by hot-water meters, the steam by a standardized orifice and the horsepower by a shaft torsion dynamometer. On account of these methods the paper was criticized by a few persons in the discussion that followed its presentation. The authors, however, explained the service conditions that excluded more desirable methods.

A paper "Trials of the U. S. Scout Cruiser 'Chester,'" was presented by Mr. C. P. Wetherbee, of The Bath Iron Works, Bath, Me. The results of four preliminary acceptance trials were briefly presented. On these the shaft horsepower could not be determined and, as the vessel was turbine driven, the indicated power was merely estimated. Incidentally Mr. Wetherbee emphasized the satisfaction resulting from the combination of bent-tube boilers, with rugged scantlings, for steam turbines. We quote from the author's conclusions:

Light machinery installations have been constructed in the past for torpedo boats and destroyers, but through the use of short-life boilers of very light scantlings and delicate parts in the main engines and auxiliaries, durability and reliability have been sacrificed.

The machinery of the "Chester" is not of this class. Lightness per unit of power is obtained through thermodynamic efficiency and high output per unit of surface. The boilers are of rugged design and have large, thick tubes. Their casings are heavy and durable. After 14,000 miles, one small part of the casing only has shown any effect of service. A slight thickening at this spot, and the addition of four small baffles about 6 ins. square in the soot-boxes at the bottom of each boiler, will remedy this difficulty. Furthermore, the boilers can readily be cleaned. These boilers can be forced to evaporate 11 to 11.5 lbs. of water per sq. ft. of heating surface under service conditions. They are not light per unit of surface, but their ability to indefinitely withstand heavy forcing and show good efficiency makes them extremely light per unit of power developed.

Machinery of the "Chester's" type is perfectly suitable for our battleships and armored cruisers. Its adoption will give our country ships that are a knot faster than foreign ships of the same displacement without any increase in machinery weight.

Mr. J. W. Powell, of Wm. Cramp & Sons' Ship & Engine Building Co., Philadelphia, presented "Some Remarks on the Steam Turbine." This gave an incomplete historical review of turbine developments and briefly discussed impulse and reaction types of turbines. The claims of the Zoelly system were touched upon.

This paper, the author, and the Cramp Co. were severely criticized by Rear Admiral Francis T. Bowles, President of the Fore River Shipbuilding Co., which controls the patent rights for the Curtis marine turbine. As the discussion turned into a dispute on patent rights the society voted to exclude the paper and all discussion from the proceedings.

"The Transportation of Submarines" was a paper by Naval Constructor W. J. Baxter, U. S. N., of Brooklyn, N. Y., in which a scheme was pictured for transporting two submarines (length over all 64 ft. 9 ins.; diameter outside of hull 11 ft. 10 ins.) on a collier and for launching them overboard at the destination.

The long paper by Lieut.-Commander L. H. Chandler, U. S. N., "Deviation of the Compass Aboard Steel Ships—Its Avoidance and Correction," was, in fact, a complete treatise on this subject. The methods of study were mathematical and the conclusions were illustrated by practice in the U. S. Navy. A great amount of data on the behavior of magnetic instruments were presented as obtained on the cruise of the Atlantic fleet from New York to San Francisco. Lieut.-Commander Chandler was navigator of the "Connecticut" from New York to Magdalena Bay.

All magnetic forces acting on the needle were resolved into three components acting to head, to starboard and to keel. These forces were the directive force of the earth's field and the deviating forces of the iron ship. The latter forces are of two kinds: (1) those due to the permanent magnetism of the ship, a more or less stable condition, and (2) those due to the "soft" iron of the ship being magnetized by the earth's field and changing its character with every movement of the ship. The actual methods of compensation by fore-and-aft, thwart ship and vertical magnets and by thwart ship masses of soft iron, all placed in or on the ship's binnacle were clearly outlined.

The practical points of the paper were illustrated by a fully-equipped battleship's binnacle and a set of ship's magnetic instruments.

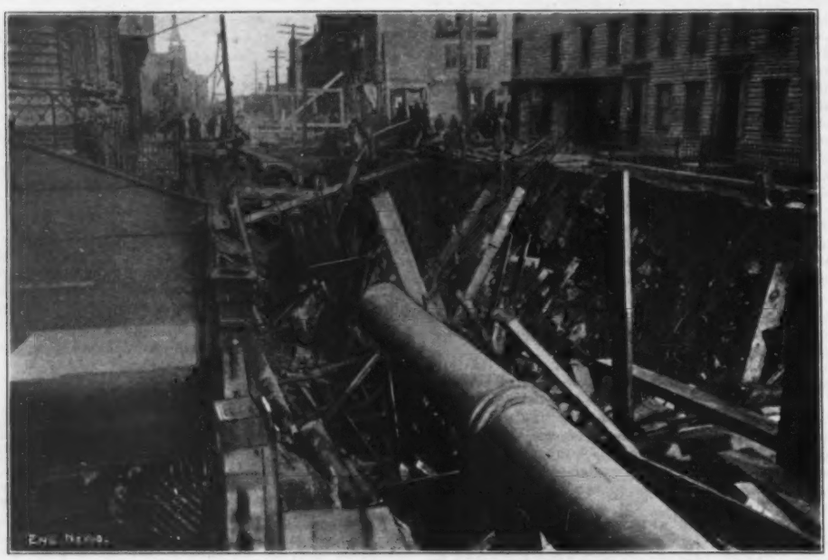


FIG. 1. THE GOLD ST. SEWER CAVE-IN.
(View looking toward Front St. Concrete manhole and elbow of gas main in back-ground.)

A NOVEL BRIDGE is to be built over the Mississippi River at Keithsburg, Ill., for the Iowa Central R. R. Co., replacing an existing bridge. The new feature is that the draw-span which is required for navigation will be so arranged that it can be shifted to different spans of the bridge, as the channel shifts. The draw is a lift span, like that of the Halsted St. Bridge in Chicago, Ill. The lifting-towers, however, instead of being fixed, are adapted to be capable of being moved from a position flanking the original lift span to a similar position in relation to another span, several of the spans being detailed for possible duty as lift spans. The entire bridge comprises ten truss spans of 200 ft., two girder spans of 103 ft. and 22 girder spans of 67 ft., totalling about 4,000 tons of steel. The bridge has been designed by Waddell & Harrington, Kansas City, Mo. The Union Bridge & Construction Co., of Kansas City, will build the foundation and superstructure, the steel work being fabricated by the McClintic-Marshall Construction Co., of Pittsburg, Pa.

CAVE-IN OF THE GOLD ST. SEWER, BROOKLYN, N. Y.

On the morning of Friday, N[illegible] about 200 ft. of the side walls of the excavation for a new sewer being built in open cut [illegible] Gold St., between Front and York Sts., Brooklyn, N. Y., caved in, burying in the bottom [illegible] number of workmen and carrying down [illegible] the collapse several bystanders. On account [illegible] the extreme difficulty in getting to the bottom [illegible] the debris it is not known just how many [illegible] were lost in the accident but, to the time [illegible] going to press, 6 bodies had been recovered. The exact cause of the collapse is not [illegible] known, and it is now under investigation [illegible] both coroner's and grand jury, but the [illegible] in the case so far as obtainable on account [illegible] the wrecked condition of the hole are given below.

The Gold St. Sewer, a 13 ft. [illegible] circular concrete conduit, had been [illegible] ted from both city and river ends, and is [illegible] completed for its whole distance except for [illegible] about 300 ft. south of the north side of Front [illegible] the fifth cross street south of the East River. This stretch was in open cut at the time of the cave-in, uncovered except for [illegible] planked crossing at Front St., just under which the completing fill was being made. Gold St. is about 80 ft. wide between building lines and about 60 ft. between curbs, lined at this point with small frame and brick dwellings. The sewer cut proper was only 17 ft. wide, so that there was about 20 ft. between either side of the cut and the curb, with sidewalks about 10 ft. wide.

The soil here is a sandy and rocky gravel, quite wet at the bottom from its proximity to the river, and on account of its flowing nature extra heavy bracing was provided. As shown in the approximate drawing, Fig. 2 (sketched from the existing bracing outside of the cave-in), the cut was about 48 ft. deep and 17 ft. wide. It was sheathed with single overlapping 2-in. plank, driven, as the excavation progressed, with a steam hammer and cross-braced every 4 ft. 6 ins. vertically and about every 6 ft. longitudinally with 10 × 10-in. and 8 × 10-in.

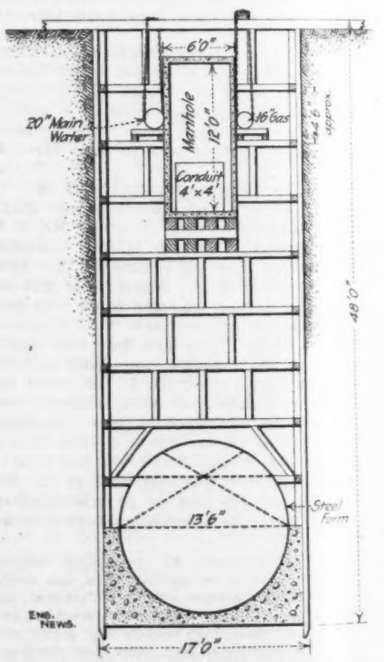


Fig. 2. Approximate Sketch of Sewer Trench Bracing, Showing Location of Manhole and Gas and Water Mains.

sticks, especially well posted and thoroughly wedged and spiked to the sheathing. The bottom once reached, a foot layer of concrete was placed and then the semi-circle of the invert, without removing the bracing. Then the cross bracing at the upper half of the circle was removed, progressively followed by the placing of sections of collapsible steel centering against

which [illegible]ides were braced before concreting was b[illegible]. At the time of the collapse, men were [illegible]hole about 100 ft. south of the south side of [illegible]nt St. engaged, under the direction of a [illegible] inspector, in removing the bracing and p[illegible] the centering preparatory to concreting.

In addition to the ordinary earth pressure sustained by the falsework, it carried one 4 × 4-ft. tile-lined concrete electric duct line, with two [illegible] concrete manholes (situated at either end of the collapse), one 16-in. gas pipe and one 2-[illegible] low-service water pipe. The electric duct line was about in the middle of the street and extended along the whole work, as did also the water main, but the gas main coming through the middle of the street from the gas tanks near the river was turned, during the sewer construction, on a right angle at the south side of Front St. and continued therefrom toward the city in a temporary line upon the west sidewalk of Gold St. In addition there was a high-pressure water main outside the line of cut at this point. Here, then, was the situation last Friday morning: an open cut, well braced, in Gold St., running south from the south intersection of the east and west Front St., which crossed the cut on a timber planking. At the south end of this planking was a 12 × 12 × 6 ft. manhole, with 6-in. concrete walls, out of which ran the concrete electric duct supported by the falsework bracing either by blocking or chains. To the west of the manhole there was a 20-in. water pipe, supported the whole length of the cut by chains and blocks (see Fig. 2) and to the east was the elbow of the 16-in. gas main just there leaving the cut for the sidewalk.

The collapse was sudden, so sudden in fact that there are no authentic accounts of the sequence of events. There was an explosion and a crushing and wrenching of timbers and then a deliberate settlement of the entire street to the building line into the pit. Immediately thereafter the 16-in. gas main caught fire and set fire to the nearby timbering, and to complete the destruction the broken water main soon filled the hole, precluded all possibility of human escape. The extent of the collapse can be seen in Fig. 1, which is taken from the south end of the hole looking north toward Front St. It will be noticed that nearly the whole 80 ft. of street has caved in. With the exception of four men who were working under the sewer centering and who escaped through the 1,200 ft. of completed sewer, to the river, all the men in the hole were killed.

After the collapse the destruction was so complete that the cause of the accident is hard to discover. The hole itself, as shown in Fig. 1, is merely a mass of earth and broken and scorched timbers. There is ample evidence of an explosion, aside from the testimony of bystanders. The big cross-timbers which were directly in front of the Front St. manhole are all pointing down and away from the manhole and the adjoining gas-main which takes its elbow at this point. The front end of the manhole is sheared off as though with a knife and, what is more important, its vertical 6-in. side walls have wide horizontal cracks which, in view of the very heavy underblocking, could hardly have been caused by a weight dropping upon the manhole or by the shearing off of the duct, but most certainly could have been caused by an interior explosion. The gas-main, just adjoining the manhole, is not shattered as by an explosion, but is sheared off clearly as by a falling weight. In view of the apparent sufficiency of that portion of the sheathing and bracing still left in place, it seems hardly probable that the timbering could have been the original source of the trouble. With the cross-braces 7 ft. on centers, in line with the trench, it seems improbable that any failure could occur so suddenly as not to give some warning or as to cause the sagging of the gas-pipe and consequent explosion in so short a time as to make it seem coincident with the falling and crushing timbers. The appearance of the pit near the manhole, the testimony of eye-witnesses, the condition of the manhole and the gas-pipe, seem to point to an explosion in the electric manhole, which destroyed the cross-bracing nearby, thus dropping the electric duct and breaking the water-main, the impact of the former and the rush of water from the latter adding to the destruction. Once the cave-in was started the completion of the collapse was an almost certain consequence, on account of the unstable nature of the ground. This conclusion is based entirely on the evidence in hand four days after the accident before the entire trench has been cleaned out and before any sworn evidence has been presented. The investigations of a jury may bring to light information not now available.

On account of the very instability of the ground here and the extent of the cave-in it was impossible to go immediately to the work of rescue, because of the danger of a further cave-in on the rescuers. So a new line of sheet piling was driven at about the same line as the original sewer and back of this a fill was made to hold the houses from further slipping. This completed, the work of rescue was commenced and it was not until Monday afternoon that the first body was recovered from the hole. The bottom of the hole has not been reached as yet, but from the contractor's records it is thought that there were about eight workmen killed. In addition, two boys who were playing on the street were carried into the slide and killed and one bystander lost his life in saving a woman and child from the cave-in.

NOTES FROM ENGINEERING SCHOOLS.

UNIVERSITY OF TORONTO.—A portrait of Prof. John Galbraith, Dean of the Faculty of Applied Science and Engineering, and Professor in Civil Engineering, University of Toronto, Canada, was recently presented to that University by its graduates and under-graduates, and now hangs in Convocation Hall. Mr. E. W. Stern, '84, of New York City, made the presentation address. The purpose of the gift is to commemorate the 30th year of Prof. Galbraith's connection with the Faculty and to be a testimonial of the universal appreciation and affection of all those who have had the good fortune to be among his pupils.

The growth of this institution under his guidance has been phenomenal. Commencing in 1878 with but a mere handful of students, there are now 770 in attendance in the classes. While most of these are from Canada, a number have come from all parts of the world, even as far away as Australia. The teaching staff likewise has increased in similar proportion, from six in 1878 to 69 in 1908.

While this remarkable growth of the school may be partially due to the great development of the material resources of Canada in recent years, its rank among the leading engineering institutions of the world must be largely ascribed to Dean Galbraith's ability as an educator and his personality, for his popularity with his old pupils is proverbial throughout Canada. As a teacher he has been most thorough and capable. Never formal or pedagogic in his methods, he has always endeavored to thoroughly ground his students in first principles and to make them think for themselves.

Dr. Galbraith was a member of the Royal Commission of the Quebec Bridge Enquiry and as such rendered signal service to his country and the engineering profession. He was one of the founders of the Canadian Society of Civil Engineers, served on the Council for many years, and last year was elected its President, on which occasion a portrait and biography were published in Engineering News of Feb. 6, 1908.

THE BURSTING OF A RENDERING VAT in the railway yards of Armour & Co. in Chicago caused the death of one man and injured five others. The vat was being tested with compressed air.

THE BOILER OF THE RIVER STEAMBOAT, "H. M. Carter," exploded Nov. 21 on the Mississippi River, eight miles south of Plaquemine, La. A fire followed the explosion and the vessel was burned to the water's edge. Seven persons were killed and twelve others injured, while the cargo of sugar was entirely lost. It is stated that this boat had been sunk and raised again four times during her career.

FOUR MINE ACCIDENTS have been reported this week. As the result of a fire in the No. 3 mine at Pratt City, Ala., Nov. 16, eight convict miners were burned to death. It is claimed that the 50 convicts employed in the mine had started the fire in the hope of making their escape. Those who were not overcome by the fire were retaken by guards as they came out of the mine.

Two miners were knocked from the bucket in which they were being lowered into the Beaver Mine at Cobalt, Ont., Nov. 16, fell to the bottom of the shaft and were killed. The heavy crosshead which followed the bucket is said to have stuck in the guides near the top of the shaft, the bucket going on down without it. The crosshead then became loosened and dropped, knocking the two men from the bucket. The shaft is 225 ft. deep and the accident occurred when the bucket was less than half way down.

A fire in the Northwestern Improvement Co.'s mine at Red Lodge, Mont., Nov. 20, resulted in the death of six miners. It is believed that about 60 others are entombed in the burning mine.

A premature explosion in the new shaft of the Union-Connellsville Coal & Coke Co. at Simpson, Pa., Nov. 19, killed one miner and injured four others.

RAILWAY ACCIDENTS which have occurred between Nov. 16 and 22 are responsible for 23 deaths and about twice that number of serious injuries. The boiler of a locomotive drawing a freight train on the St. Louis & San Francisco R. R. exploded Nov. 16 at Hayti, Mo., killing two men and demolishing 16 loaded box cars. Two others of the train crew were badly injured.

A freight train on the Canadian Pacific Ry. ran into a washout at Lyton, Ont., Nov. 17. The locomotive and three cars left the track killing the engineer and fireman and fatally scalding the brakeman who died soon after the accident.

A passenger train on the Baltimore & Ohio R. R. left the track on a 40-ft. embankment between Cowen and Camden-on-Gauley, W. Va., Nov. 17. Five trainmen and 20 passengers were badly injured.

A freight train on the Canadian Pacific Ry. left the track at a frog while running at a high rate of speed into the yards at Rideau Junction, east of Ottawa, Ont., Nov. 18. The locomotive went down a slight embankment and two cars were demolished. The fireman was instantly killed and the engineer and brakeman seriously injured.

A peculiar accident on the Sixth Ave. elevated line in New York City, Nov. 18, resulted in the death of two workmen and the injury of several others. A work-train made up of an old, empty passenger car, a flat car loaded with rails and a derrick car was running at full speed north on Sixth Ave. The derrick had been raised to be ready for unloading at 25th St. As the train passed under the overhead foot bridge at 23d St., the arm of the derrick struck the bridge and fell among the workmen on the car, killing two as noted above. In falling it scraped the side of a passenger train just leaving the 23d St. station, breaking several windows, but none of the passengers were hurt.

A freight train collision on the Chicago, Rock Island & Pacific Ry., Nov. 20, near Brinkley, Ark., resulted in the death of one man and the injury of four others. Two cars were destroyed by the fire which followed the wreck.

A handcar on the Chicago, Burlington & Quincy R. R. was struck by a passenger train at Highlands, 17 miles west of Chicago, Ill., Nov. 20. Seven of the track laborers on the car were instantly killed. It is said the accident was due to the mistake of the laborers, who were on the wrong track.

Two accidents occurred in the suburbs of Chicago during the heavy fog of Nov. 21. A suburban train on the Wabash R. R. struck the rear of a freight train which did not clear a siding in time, killing the engineer of the suburban train. The accident occurred near Chicago Ridge. A Wisconsin Central and an Illinois Central freight train met head-on in the yards at Berwyn. Both engines were demolished and one fireman was killed.

A head-on collision between two freight trains on the Ann Arbor R. R. occurred near Lakeland, Mich., Nov. 21. Two men were killed and three others injured. The trains were running at full speed and both locomotives were demolished. The collision occurred on a straight stretch of track, a heavy fog prevented the engineers from seeing each other's trains in time to prevent the accident. The wreck is ascribed to a confusion of orders.

In a head-on collision between two freight trains on the Atlantic Coast Line R. R., near Suffolk, Va., Nov. 22, one man was killed and several others injured. Both locomotives and 21 loaded cars were wrecked and afterward burned by the fire which followed. The accident was due to a misunderstanding of orders and a heavy fog.

A double-headed freight train on the Canadian Pacific Ry., Nov. 22, ran at full speed against an-

other freight which was waiting for it to pass on a siding near Burketon Junction, Ont. Three men were killed and one injured. One train had already passed the waiting freight and it is believed that the switch was opened by an inexperienced brakeman who did not know the second train was expected.

THE COLLAPSE OF A THEATER is reported from Winnipeg, Man. The building had just been completed, at a cost of $30,000, when it collapsed during the evening, "covering the sidewalk with debris" but injuring no one.

A TORNADO IN ARKANSAS Nov. 23 destroyed portions of several towns and hamlets, causing the death of four persons and injuring about four times that number. The force of the storm was greatest in the vicinity of Ozark, Ark., and Cravens, a small town four miles west of Ozark, was entirely wiped out. Knoxville, Barr, Wallerville, Jethro and Berryville are among the towns affected.

WORK AT GATUN DAM.—The rock toe at the upstream or south end of Gatun Dam is almost up to the elevation decided on, that is, 60 ft. above sea level. The toe is constructed of Bas Obispo rock and runs gradually up to its highest point. It extends from the old line of the Panama railroad to the spillway. When completed the toe will be at an elevation of 60 ft. along its entire length, that is, clear across the valley. This toe is not the dam proper, but is only a retaining wall for the dredged material which will form the dam. Beyond the spillway channel a dump has been started along the west diversion of the Chagres River, extending from the line of the rock toe southward to the limit of the fill it is proposed to make on this toe. The toe cannot be extended across the west diversion until the concrete work in the spillway is finished above the high water line of the river.

Spoil from the cut at Mindi is being dumped on the north toe of the dam, and this toe also is assuming something of the appearance it will have when completed. The dump will be extended clear across the valley and so far north that it will include the ground on which the Gatun Island hotel is located. Between these two toes, a distance of 1,700 ft., the hydraulic fill will be made, or, in other words, the dam proper will be located.

The unwatering of the old bed of the Chagres, between the two toes, is almost completed and it will be possible in a few weeks to begin the work of scraping the layer of silt from the bottom. The whole dam site will be cleared of the loose earth covering before the hydraulic fill is begun.—"Canal Record," Nov. 11.

AN INCREASE IN IDLE FREIGHT CARS is reported for Nov. 11, the first since the middle of July. The figures for Nov. 11 are 121,174 surplus cars, against 110,912 two weeks before (an increase of 10,262 in two weeks). The change includes an increase of 4,000 in box cars, an increase of 8,000 in coal, gondola and hopper cars, and a decrease of 2,000 in other kinds of cars. There are about the same numbers of shortages, mainly on the Canadian lines, the total being 11,659 cars, against 10,839 two weeks previously. Bad-order (shop) cars have been decreased by nearly 13,000 (the total not being stated, but probably about 150,000), so that there still is a slight actual increase in the number of utilized cars.

CONTRACTS ON THE NEW YORK BARGE CANAL, amounting to 5½ million dollars, were awarded by the Superintendent of Public Works of New York, Hon. F. C. Stevens, on Nov. 19. The following are the awards, the prices being based on the engineer's estimate of quantities:

Contract No. 40, to the United Engineering and Contracting Co., 32 East 33d St., New York, for the sum of $2,166,298.

Contract No. 41, to Butler Bros.-Hoff Co., 1170 Broadway, New York, for the sum of $281,330.

Contract No. 46, to the Kinser Construction Co., Fort Edward, N. Y., for the sum of $1,212,833.

Contract No. 47, to the Crowell & Sherman Co., 3111 Carnegie Ave., Cleveland, Ohio, for the sum of $1,262,638.

Contract No. 68, to Shanley-Morrissey, Inc., 527 Fifth Ave., New York, for the sum of $1,018,323.

A DELAWARE RIVER TUNNEL PROJECT is involved in the incorporation of two companies last week in New Jersey and Pennsylvania under the name Delaware Railroad Tunnel Co., by the Philadelphia banking firm of Wolf Bros. and the engineering firm of Stern & Silverman. The plan is to build two tunnels from Market St., Philadelphia, to Third St., Camden, for street-railway passenger service.

THE LARGEST WOODEN SCHOONER afloat is said to be the "Edward B. Winslow," which was launched from the yard of Percy & Small at Bath, Me., Nov. 24. The "Edward B. Winslow" is a six-master 318.3 ft. long with 50-ft. beam and a depth of 29 ft. The gross tonnage is 3,424. The schooner was built for the J. B. Winslow Co., of Portland, Me.

A CONCRETE CAUSEWAY across Galveston Bay is to be built by joint agreement between the city authorities of Galveston and the railway companies. The structure will be 10,280 ft. long, with an average height of 15 ft. above high tide. It will have a width of 100 ft., affording room for four railway tracks, besides a driveway and sidewalks, and the cost is estimated at $1,400,000. The County of Galveston is to pay one-fourth the cost, the electric interurban railway between Houston and Galveston, one-fourth, and the steam railways entering the city the remaining half.

PERSONALS.

Mr. Henry F. Collins, Life M. Am. Inst. M. E., has resigned as Manager of the Cerro Muriano Mines in Cordoba, Spain.

Mr. H. S. Moreland and Mr. Chas. S. Glen have opened an office as civil and industrial engineers at 411-412 Chamber of Commerce Bldg., Enid, Okla.

Mr. James Gayley, Past-President of the American Institute of Mining Engineers, has resigned his position as First Vice-President of the United States Steel Corporation.

Mr. L. W. Baldwin has been appointed Division Superintendent of the Yazoo & Mississippi Valley R. R., at Greenville, Miss., succeeding Mr. J. B. Kemp, resigned.

Mr. John R. Freeman, M. Am. Soc. C. E., and Mr. Frederick P. Stearns, M. Am. Soc. C. E., have been appointed to act as consulting engineers in connection with the improvement of the water supply of Baltimore, Md.

Mr. J. E. Hickey, Master Mechanic of the National Lines of Mexico, at Durango, Mex., has become Superintendent of Shops of the Mexican Central Ry. at Aguascalientes, succeeding Mr. G. F. Tilton who is assigned to other duties.

Mr. S. Bent Russell, M. Am. Soc. C. E., Consulting, Civil and Hydraulic Engineer, of St. Louis, Mo., who has been absent from that city for some months, has returned and is to be permanently located there. His office will be at 415 Locust St.

Mr. Samuel W. Stratton, Assoc. Am. Inst. E. E., Director, National Bureau of Standards, Washington, D. C., will deliver the founder's day address of the twelfth anniversary of the Thomas S. Clarkson Memorial School of Technology at Potsdam, N. Y., Dec. 1.

Mr. Granberry Jackson, Assoc. M. Am. Soc. C. E., has resigned his position as Adjunct Professor of Engineering at Vanderbilt University, Nashville, Tenn., to devote his time to the Jackson Phosphate Co. in which he is interested. He will continue his practice as a consulting engineer.

Mr. Geo. S. Leavenworth, M. Am. Soc. C. E., for five years Chief Engineer of the Powers & Mansfield Co., Troy, N. Y., has resigned to take an active interest in the Vermont Construction Co., at Burlington, Vt., of which he is a director. He will also do consulting engineering work.

Dr. James Douglas, Past President Am. Inst. M. E., has received from the Institution of Mining and Metallurgy of Great Britain the Gold Medal of the Institution. The medal is bestowed in recognition of his services in the advancement of the interests of mining and metallurgy and of contributions to technical literature.

Mr. James W. Beardsley, M. Am. Soc. C. E., Director of Public Works, Philippine Islands, has resigned to take charge of the design and construction of an extensive system of irrigation for the islands, undertaken by the Government. He will be succeeded by Mr. James F. Case, M. Am. Soc. C. E., formerly Chief Engineer, Department of Sewer and Water-Works Construction, Manila, P. I.

Mr. J. P. Snow, Bridge Engineer of the Boston & Maine Ry., has been appointed First Vice-President of the American Railway Engineering and Maintenance-of-Way Association. The appointment was made to fill the vacancy due to the advancement of Mr. William McNab to the position of President, consequent upon the death of Mr. Walter G. Berg. This action was taken at a meeting of the Board of Directors in Chicago on Nov. 17.

Mr. Charles W. Sherman, M. Am. Soc. C. E., who has been for 9½ years Editor of the "Journal of the New England Water-Works Association," will retire from that position, being no longer able to spare the necessary time to the work. As noted in our engineering societies' column in the issue of Nov. 5, Mr. Richard K. Hale has been nominated to succeed Mr. Sherman as Editor. Mr. Hale is a graduate of Harvard University and of the Massachusetts Institute of Technology and has been, since his graduation in 1904, with Mr. Robert S. Weston, Assoc. M. Am. Soc. C. E., Boston, Mass.

Obituary.

George Tod, President of the Hill Iron & Coal Co., died at Youngstown, Ohio, Nov. 16. He was born in Warren, Ohio, in 1840.

George W. Hurlbert, for several years Superintendent of the Worcester, Nashua & Portland division of the Boston & Maine R. R., died Nov. 18 at his home in Worcester, Mass., at the age of 67 years.

Herbert P. Seale, Life M. Am. Inst. M. E., Mining Engineer of the Mount Morgan Gold Mining Co. in Queensland, Australia, died in September. He [illegible] graduate of Sydney University and was 36 years [illegible]

Max Heberlein, M. Am. Inst. M. E., [illegible] recently at Mainz, Germany. He was born at Bran[illegible] Germany, in 1860 and was educated at Freiberg. [illegible]ame to the United States in 1882 and was in this [illegible]y for several years. Since 1902 he has been asso[illegible] with his brother in connection with the Huntingt[illegible] Heberlein process of treating lead ores. During t[illegible] year he has practiced as a consulting metallur[illegible] in Mainz, Germany.

Gustave O. Canet, Hon. M. Am. Soc. M. [illegible]ied at his home in St. Aubin sur Mer, in Calvados, [illegible]ce, Oct. 6. He was manager of the artillery works [illegible]hneider & Co. at Creusot, France, and was a recog[illegible] expert in gun construction. Mr. Canet was born at [illegible], France, in 1846, and was educated at the Strasbu[illegible]ollege and afterward at the Ecole Centrale des Arts [illegible] Manufactures. He was first engaged in railway [illegible], but in 1872 entered the employ of the London Or[illegible]ce Works Co., and has since devoted himself almo[illegible]ntirely to gun construction, having been connected [illegible] several European manufacturers of armament. He [illegible]red from active work with Schneider & Co. in 1907. Mr. Canet was a Past-President of the Société des Ingénieurs Civils de France; Honorary President of the Chambre Syndicate des Fabricants et Constructeurs de Matériel de Guerre; Honorary Member of the Imperial Technical Society of Russia and of the Iron and Steel Institute; President of the Junior Institution of Engineers; Member of the Institution of Civil Engineers and of the Institution of Naval Architects. He was also connected with numerous other institutions and societies.

ENGINEERING SOCIETIES.

COMING MEETINGS.

AMERICAN SOCIETY OF REFRIGERATING ENGINEERS.
Nov. 30-Dec. 1. Annual meeting at New York City. Secy., W. H. Ross, 154 Nassau St., New York City.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.
Dec. 1-4. Annual meeting at New York City. Secy., Calvin W. Rice, 29 West 39th St., New York City.

AMERICAN INSTITUTE OF ARCHITECTS.
Dec. 15-17. Annual convention at Washington, D. C. Secy., Glenn Brown, "The Octagon," Washington, D. C.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS.
Dec. 28-29. Annual meeting at Pittsburg, Pa. Secy., John C. Olsen, Polytechnic Institute, Brooklyn, N. Y.

NATIONAL ASSOCIATION OF CEMENT USERS.
Jan. 11-16. Annual convention at Cleveland, Ohio. Secy., Geo. C. Wright, Harrison Bldg., Philadelphia, Pa.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS.
Jan. 19. Annual meeting at New York City. Secy., W. M. Mackay, P. O. Box 1818, New York City.

AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS.—A meeting will be held at the University of Illinois, Urbana, Dec. 29-30. Mr. L. W. Chase, Associate Professor in Farm Mechanics, University of Nebraska, Lincoln, Neb., is Secretary of this society.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—At the General Section meeting held Nov. 19 in Montreal, papers were presented as follows: "Notes on Canadian Forestry," S. Gagné; "Mean Sea Level at Quebec and New York," W. Bell Dawson. Professor Brown's paper entitled "Tests of Reinforced-Concrete Beams" was discussed. At a meeting of the Electrical Section, Nov. 26, Mr. J. R. Bibbins will present a paper entitled "Some Considerations in the Application of Low Pressure Turbines to Power Generation." A meeting of the Mechanical Section will be held Dec. 3.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS.—The first annual meeting will be held in the buildings of the Carnegie Technical Schools at Pittsburg, Pa., Dec. 28-29. Among the papers to be presented are the first technical statement by Mr. James Gayley, M. Am. Inst. M. E., regarding his process for dehydrating air for blast furnaces and various other papers on fuels, dryer calculations and design and on the measurement of high temperatures. In connection with this meeting there will be an exhibition of plans and working models of new machinery. An account of the inaugural meeting of this society, held at Philadelphia, June 22, 1908, was published in our issue of July 9.

NEW JERSEY SANITARY ASSOCIATION.—The 33d annual meeting will be held at The Laurel-in-the-Pines, Lakewood, N. J., Dec. 4-5. The following papers will be presented: Dec. 4, "Sanitary Inspection of Schools," W. G. Schauffler; "The Necessity for Schools of Instruction for Health Officers," John L. Leal; "Symposium on Tuberculosis," four separate papers by E. B. Voorhees, Wm. C. Smallwood, S. B. English and Theodore Seaman; "The Washington, D. C., Aqueduct and Filtration Plant," E. D. Hardy, M. Am. Soc. C. E.; "The Progress of Mosquito Extermination Work in New Jersey," John B. Smith. Dec. 5, "Pollution of the Delaware River; Its Cause and Remedy," Harry M. Herbert; "The Modern Treatment of Sewage," Emil Kitchling; "The Prevention of Dust on Highways," James Owen.

CONSTRUCTION NEWS

Supplement to ENGINEERING NEWS. 220 Broadway, New York, November 26, 1908.

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CONSTRUCTION NEWS.

PLANS AND SPECIFICATIONS ON FILE.

(denotes that this work is advertised in Engineering News.)*

The following plans (P.) and Specifications (S.) are on file and may be seen at the office of The Engineering News Publishing Co., 220 Broadway, New York.

Bids close.	Work.	Place.	See issue.
11-27	Sewage pumping machinery,	Grand Rapids, Mich..	(P. & S.) 11-12
11-28*	Railway, dry-dock,	St. Louis, Mo.	(P. & S.) 11-29
11-30	Pipe, etc.,	Gridley, Cal.	(S.) 11-19
11-30	Aqueduct,	Los Angeles, Cal..	(S.) 10-22
12- 1	Dredging,	Hawaii	(S.) 9-17
12- 2*	Superstructure,	Evanston, Ill.	(S.) 11-19
12- 4*	Earth dam,	Springfield, Mass.	(S.) 11-12
12- 9*	Dredging,	Savannah, Ga.	(S.) 11-12
12- 9*	Dredging,	Boston, Mass.	(S.) 11-12
12-12*	Pile pier,	Mich. City, Ind.	(S.) 11-12
12-14*	Bridge,	Green Bay, Wis.	(P. & S.) 11-19
12-14*	Steel tank and tower,	Gridley, Cal.	(S.) 11-19

LIST OF CONTRACTS PENDING.

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11-30 Elec. supplies, Wash., D. C. 11-19
12- 2 Light and power, New York.....11-19
12- 2 Transmission lines, Ft. Sam Houston, Tex. 11-12
12- 2* Elec. equipment, Gowanda, N. Y.11-26
12- 7 Power equipment, etc, N. Y.....11-26
12- 7 Light and heat, etc., N. Y.....11-26
12-11 Power-house, Cincinnati, Ohio..11-19
12-16 Power plant, Agnew, Cal. 11-26
1- 4 Lighting, Hartford, Conn.....11-12

BRIDGES.

11-30 Rebuilding bridge, Lepreau, N. B.11-19
11-30 Rebuilding bridge, Havelock, N.B.11-19
12- 2* Superstructure, Evanston, Ill.....11-19
12- 3 Bridges, Rochester, N. Y. 11-26
12- 5 Bridges, Wichita, Kan. 11-26
12- 7 Bridges, Valparaiso, Ind. 11-26
12- 7 Bridges, Vicksburg, Miss. 11-26
12- 7 Bridge, Gulfport, Miss. 11-26
12- 7* Viaduct, Kansas City, Mo. 11-12
12- 7 Bridge, Grenada, Miss. 10-29
12- 8 Bridges, Princeton, Ind. 11-12
12- 9* Bridge, etc., Mamaroneck, N. Y..11-26
12-14* Bridge, Green Bay, Wis. 11-19
12-16 Substructure, etc., Columbus, O.11-12
12-24 Bridge, Sumner, Wash. 11-26
1-12 Bridge, Rensselaer, Ind. 10-29

BUILDINGS.

11-27 Residence, New York 11-19
11-27 Schools, Philadelphia, Pa. 11-19
11-27 Warehouse, Cincinnati, O. 11- 5
11-27* Post-office, Milford, Del. 10-29
11-30 Post-office, Manchester, Va. 11- 5
11-30 School, Torrington, Conn. 11-26
11-30 Flooring, Wash., D. C. 11-26
11-30 School, St. Joseph, Mo. 11-26
11-30 Boiler house, etc., New York...11-19
11-30 Infirmary, New York 11-19
11-30 Court-house, etc., New York....11-19
12- 1 Removing bldgs., New York....11-19
12- 1 Building, Muncie, Ind. 11-12
12- 1* Post-office, Newton, Kan. 10-29
12- 1 Quarters, Ft. Hamilton, N. Y....11-12
12- 1 Building, Wash., D. C. 11-12
12- 1 Granite, Edmonton, Alta. 11-26
12- 2* Post-office, Carlisle, Pa. 10-29
12- 3 Market, armory, Richmond, Va..11-26
12- 3 Foundations, New York. 11-19
12- 7 Nurses' home, New York 11-26
12- 7 Jail, Lebanon, Ind. 11-12
12- 7 Library, Covington, Ky. 11-26
12- 7 Schools, New York. 11-26
12- 7 Infirmary, Oak Park, Ill. 11-26
12- 8 Stable, Ft. Benj. Harrison, Ind.11-26
12- 8 Post-office, Gainesville, Ga. 11-12
12- 8 Fire houses, New York 11-26
12- 9 Buildings, Columbus, Ohio. 11-19
12- 9 Flour and sawmill, Jocko, Mont. (Mfg. Pl.) 11-19
12-14* Buildings, Ft. Meade, S. Dak...11-12
12-15 School, Cincinnati, Ohio. 11-26
12-18 Steel, Madison, Wis. 11-19
12-19 School, Passaic, N. J. 11-27
12-19 Court-house, St. Anthony, Idaho..11-26
12-20 Barns, East Liverpool, Ohio. 11-26
12-21* Hydrotherapeutic equipment, Hot Springs, S. Dak. 11-26
12-21 Crimb. bldgs., Seattle, Wash. 11-19
12-22 Post-office, Coldwater, Mich. 11-19
12-22 School, Jersey City, N. J. 11-26
12-23 Post-office, Alexandria, Minn...11-19
12-50 Post-office, Americus, Ga. 11-19
12-28 Post-office, Lake Charles, La....11-19
12-29 Post-office, Alton, Ill. 11-26
1- 4 Post-office, Sault Ste Marie, Mich.11-26
1- 5* Post-office, Niles, Mich. 11-26

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11-27 Filtration plant work, Sandusky, Ohio 11-26
11-30 Hydrants, Winnipeg, Man. 11-26
11-30 Dam, Cheyenne, Wyo. 11-19
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12- 1* Cast-iron pipe, etc., Greenville, Tex. 11-19
12- 1 Water-works, Wilton, Wis. 11-19
12- 1* Pressure tunnel, New York. 11-12
12- 1* Reservoir, Yorkville, Ill. 11-12
12- 2 Water-works, Covington, Ga. 11-19
12- 4 Drain, Springfield, Mass. 11-12
12- 3 Water meters, Grand Rapids, Mich. 11-26
12- 6* Water-works, Murdo, S. Dak. 11-26
12- 7 Pumping station, Murdo, S. Dak.11-26
12- 8* Cast-iron pipe, Amsterdam, N. Y.11-26
12- 8 Reservoir, engine, Meridian, Miss.11-19
12- 9 Water mains, New York. 11-26
12-14* Steel tank and tower, Gridley, Cal. 11-19
12-15* Well, Herrin, Ill. 11-26
12-15 Tower and tank, Eveleth, Minn..11-26
1-15* Cement, Portland, Ore. 11-26

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11-27 Sewage pumping machinery, Grand Rapids, Mich. 11-12
11-27 Sewer, Toledo, Ohio 11-19
11-27 Sewers, Lexington, Neb. 11-19
11-30* Sewer, Washington, D. C. 11-19
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12- 1 Sewers, etc., New York. 11-19
12- 2 Sewers, New York 11-19
12- 2 Pipe sewer, Steubenville, Ohio...11-26
12- 2 Sewer, Brooklyn, N. Y. 11-26
12- 7 Sewer, Muskegon, Mich. 11-19
12- 8 Sewer bonds, El Centro, Cal. 11-19
12- 8 Sewers, New Brighton, N. Y. 11-26
12- 8 Sewer extension, Hobart, Okla. 11-26
12-15 Sewer, Toronto, Ont. 11-26

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11-27 Sidewalk, Tuscaloosa, Ala. 11-26
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11-27 Street repair, Columbus, Ohio...11-12
11-28* Macadam, etc., Hillsdale, N. J..11-19
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12- 4 Grading, Olympia, Wash. 11-26
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12- 7 Road, Vernon, Ind. 11-19
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12- 7 Grading, etc., Muskegon, Mich..11-26
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12- 8 Road, Crawfordsville, Ind. 11-19
12- 8 Road, Madison, Ind. 11-19
12- 9 Road, Lafayette, Ind. 11-19
12- 9 Roads, Muncie, Ind. 11-19
12- 9 Roads, Corydon, Ind. 11-19
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12-10 Roads, Frankfort, Ind. 11-26
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12-14 Roads, Fort Riley, Kan. 11-26
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11-27 Drains, Boone, Idaho 11-26
11-27 Breakwater, wharf, Ottawa, Ont..11- 5
11-27* Wharf, Wash., D. C. 11-12
11-28* Ry. dry-dock, St. Louis, Mo. 10-29
11-30 Sale of Elec. Ry., Aurora, Ill. 11-12
12- 1 Dredging, Hawaii 9-17
12- 1 Vacuum cleaning, Wash., D. C..11-12
12- 1 Excavation, Tiffin, Ohio 11-12
12- 1 Lumber, Leavenworth, Kan. 11-19
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12- 1 Supplies, Toronto, Ont. 11-26
12- 2* Greenhouses, Albany, N. Y. 11-26
12- 3 Storage cabinets, New York. 11-19
12- 3 Railing, New York 11-26
12- 3 Setters, New York 11-26
12- 3 Repairing ferryboats, New York.11-26
12- 3 Pipe fences, New York 11-26
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12- 4 Drain, De Kalb, Ill. 11-26
12- 4 Dredging, Boston, Mass. 11-26
12- 4* Gymnastic apparatus, Prescott, Ariz. 11- 5
12- 4* Tunnel, shaft, elevator, Niagara Falls, N. Y. 11-19
12- 5 Wharf, dredging, Norfolk, Va. ..11-26
12- 9* Dredging, Savannah, Ga. 11-12
12- 9* Dredging, Boston, Mass. 11-12
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CIVIL SERVICE.

12- 2 Junior Chemist, Wash., D. C....11- 5
12- 2 Junior Engr., Wash., D. C. 11- 5
12- 2 Office Engineer, Wash., D. C. ...11-19
12- 9 Computers, Wash., D. C. 11-19
12- 9 Assistant, Wash., D. C. 11-19
12- 9 Asst. Inspector, Wash., D. C. ...11-19
12-15 Laboratory Asst., Wash., D. C...11-19

RAILWAYS.

AMADOR CENTRAL.—This company has executed a mortgage in favor of the Union Trust Co. for $300,000. The mortgage is to serve as the basis for a 30-year 5% bond issue. It is set forth that the money raised through the sale of bonds is to be used in building a railroad from Ione to Martel, in Amador County, Cal., or in the acquisition of the property of the Ione & Eastern Railroad Co. Noted on Oct. 1.

BUFFALO, ROCHESTER & PITTSBURG.—Engineers are going over the main and branch lines north of Pittsburg, making preliminary surveys and plans for new construction work and improvements to be taken up next spring. The engineers are at work in the southern part of Indiana County, Pa., where the company intends to extend its lines, and build new shops and yards. It is stated that for the present the company will devote most of its time to the construction of spurs to reach some of the new coal mines and manufacturing plants. W. T. Noonan is Gen. Mgr., Rochester, N. Y.

CALGARY & KNEEHILL.—Incorporated to build a line from Calgara, Alta., northerly to Kneehill Creek. Company will apply for an extension to March 15, 1909, of the time within which the first 30 miles of line is to be built, and a further extension of two years from that date for the completion of the rest of the line. Noted on Oct. 1.

CANADA.—McCarter & Macdonald, attorneys, Victoria, B. C., are applying for an act of Parliament to enable the construction of a line of railway from a point at or near Corbin, B. C., in a southerly direction to the American boundary, a distance of about 40 miles. This line will be built by the D. C. Corbin interests, of Spokane, Wash.

CHICAGO, MILWAUKEE & ST. PAUL.—Roswell Miller, Chn. of the Board of the Chicago, Milwaukee & St. Paul, has denied a report that this company would probably issue $100,000,000 of bonds against the lines of the company constituting the Pacific coast extension, and their equipment. Noted last week.

DAYTON, LEBANON & CINCINNATI R. R. & TERMINAL CO.—This company is seeking entrance into Dayton, Ohio, to make a connection between Dayton and Cincinnati. The line now connects Lebanon and Lebanon Junction, 23 miles. Frank Brandon is Pres., Lebanon, Ohio.

DENVER & RIO GRANDE.—See Santa Fe Central.

FLAG RIVER.—We are officially advised that date for letting construction contracts is undetermined. Survey has not been made nor has right-of-way or capital been secured. This railroad will extend along the south shore of Lake Superior from Superior, Wis., to Flag River, a distance of about 40 miles. B. C. Cooke is Pres. and James Bardon, Vice-Pres., Superior, Wis. Noted on Oct. 29.

GOOSE LAKE & SOUTHERN.—Surveys are now under way by the engineers of this company which was incorporated in California to build from Goose Lake on the Oregon-California State line to Anderson, Shasta County, Cal. The northern terminus will be at a connection with the Oregon Eastern Railway and the line will pass through Modoc, Lassen and Shasta Counties to a connection with the Southern Pacific at Anderson, a distance of 227 miles. The branch line will extend through Modoc, Lassen, Plumas and Tehama Counties to Vina, a distance of 79 miles. The capital stock is $13,398,000. The incorporators are officials of the Southern Pacific Railroad and include E. E. Calvin, William F. Herrin, W. H. Scott and J. L. Willcutt. Noted on May 21.

GRAND TRUNK PACIFIC.—A sub-contract for the construction of a section of the Trans-Continental Railway above Fort William, Ont., has been awarded to FORTIN & GRAVELLE, of Hull, Ont., at an estimated cost of $500,000. This section is ten miles in length.

GULF & MAGNOLIA NORTHERN.—We are officially informed that surveys are partially made for this proposed railroad which will be built from Magnolia, Ark., northwest via Waldo to Hope, 35 miles. W. Y. Foster, Pres., Hope; J. M. Davis, Vice-Pres., Waldo, and J. L. Davies, Treas., Magnolia. The headquarters of the company are at Hope. C. N. Black is Ch. Engr., Hope.

LYNNHAVEN TERMINAL.—The charter of the Lynnhaven Terminal Corporation provides that the company may lease, purchase or construct and operate a railroad with main line 50 miles long through or into the cities of Norfolk and Cape Charles and the counties of Northampton, Princess Anne and Norfolk, Va. Company may also build breakwaters in Lynnhaven or lower Chesapeake Bay, lease or construct and operate wharves, docks and warehouses. No construction is planned for a year.

MEMPHIS R. R. TERMINAL.—The company has accepted the ordinance granting a franchise for the proposed Union Railroad terminal, which will cost about $3,000,000, and in which the various lines entering Memphis, Tenn., are interested. O. F. Christ is Secy. of the company; W. H. Harrison is Ch. Engr., and John H. Watkins is Pres.

MEXICO.—The contract entered into between Ing. Leandro Farnandez, Secy. of the Department of Communications and Public Works, and Manuel F. Villaseñor, representing Pedro Ruiz and Manuel L. de Guevara, concessionaires for the construction of the Santecopaman to Caleria Railroad, District Tuxtlas, State of Veracruz, was cancelled on Nov. 3. The plans for the construction of the road, which the company presented to the Department of Communications, are left in the possession of the Mexican Government, and they may be disposed of by the same department as it deems it convenient.

On the other hand, the government will return to the concessionaires the deposit of $3,000 in bonds of the public debt, which constituted the guarantee for the fulfillment of the contract now cancelled.

MODOC NORTHERN.—B. F. Knowlton, Engr., and a party of surveyors are making their way from Tule Lake southeastward toward Alturas with the preliminary survey for the Modoc Northern Railway, which was incorporated recently by the Southern Pacific Co., to construct a line from here to connect with the California Northeastern Railway at a point near Klamath Falls, Ore. It is reported that this preliminary survey is so satisfactory as to grades, curves and character of country traversed that it is extremely likely it will be chosen as the route for the new railway. There will be no important engineering feats to perform anywhere along the route, the trestling of marshy ground being about the only expensive work that will be encountered. The route leads through a wide expanse of virgin timber of fine quality, and will also open up a fine agricultural and stock raising country. Noted on Aug. 6.

NORTH COAST RY.—Contract has been awarded for grading 20 miles of right-of-way west of Kennewick, Wash., which will bring the grade to within five miles of Kiona. This five-mile stretch was completed some time ago, so that when the 20-mile contract is finished there will be a continuous grade from Kennewick to Kiona. COCHRANE & WOODSON, Spokane, Wash., were awarded the contract for 12 miles and CASE & ESBACH, Spokane, the remaining eight miles.

PORT JERVIS & DELAWARE VALLEY.—Charter has been granted to this company in Pennsylvania to build a railroad from Matamoras to Milford, Pike County, Pa., seven miles. Capital stock, $200,000. The directors are Francis A. Sawyer, of Canton, Pres.; C. F. Wright, of Susquehanna; Isaac N. Beardslee, Edward P. Emerson and James S. Helden, of Port Jervis, and Representative Alfred Marvin and T. F. DeGraw, of Matamoras.

QUEBEC CENTRAL.—Survey has been completed and work has already commenced on the extension of the Quebec Central Ry. from St. George, Que., to Connors, N. B., a distance of 125 miles. This new line will serve a territory not yet supplied with railway facilities, containing areas of forest lands, with a few scattered villages. At Connors it will connect with the Temiscouata Ry., which extends from Connors to Riviere du Loup, Que., the distance being 113 miles. J. H. Walsh is Gen. Mgr. of the Q. C., at Sherbrooke, Que.

SANTA FE CENTRAL (New Mexico Central).—This railway has been acquired by the Denver & Rio Grande System, and is to be extended from Santa Fe, N. Mex., via Roswell, to El Paso, Tex., according to the El Paso "Times." The line is to run from Santa Fe, the present terminus of the Central, to Torrance, a distance of 110 miles. From Torrance to Roswell, and thence to El Paso. A force of men are already on the ground at Moriarty, preparing to construct the line from that place to the Hagan coal fields, a distance of 21 miles. The LANTRY-SHARP CONTRACTING CO., Gumbel Bldg., Kansas City, Mo., has the contract. Charles Vorhees is Engr.-in-Charge, Santa Fe.

WESTERN PACIFIC.—Traffic was inaugurated on the Eastern division of this road on Nov. 9, from Salt Lake City, Utah, west to Shafter, Nev., about 160 miles, where connection is made with the Nevada Northern Ry. Main track has been laid from Salt Lake City west for about 235 miles. At a point 170 miles west of Salt Lake City, the Flower Lake Pass tunnel, which is to be 5,600 ft. long, is nearly finished. It is stated that trains will be running through this tunnel before the end of the year.

ELECTRIC RAILWAYS.

BOSTON, MASS. — The Massachusetts Railroad Commission issued an order on Nov. 17 approving the general scheme of the Boston & Eastern Electric R. R. Co., which desires to build a high-speed interurban railroad between Boston and Beverly. The plans of the road have been before the Commission for about two years, and many hearings have been held, with a large amount of expert testimony. The details of this project were described by H. S. Knowlton in Engineering News, Aug. 20, 1908, p. 198. "In stating that public convenience and necessity have been shown by the Boston & Eastern Co., the board withholds the granting of a certificate of exigency until legislative authority shall have been obtained for the construction of a tunnel under Boston Harbor, and a subway connection with the central portion of Boston, such submarine and underground routes not having authorization under the existing laws of the state. The Boston &

Eastern Co., however, has won a substantial victory, and if the necessary legislation can be secured in harmony with the commission's own suggestion in 1907, the construction of the road is likely to be not long delayed."

NEW YORK, N. Y.—The Board of Estimate and Apportionment on Nov. 20 granted the application of the New York, Westchester & Boston Ry. Co., for a change of route in The Bronx. There was a unanimously favorable report on the application from the special committee composed of the Controller, President McGowan of the Board of Aldermen and Borough Presidents Haffen and Ahearn. The changes permit the road to shift its southern boundary from 134th St. to 174th St. and give permission to use an overhead trolley. The road can make connections with two railroads at a distance within 2,500 ft., to allow connections at West Farms and at West Chester. The city gains the right to string three cables in place of the two conduits that originally had been intended. The company gets the right to make connections with the Rapid Transit Railway at West Farms and the proposed railway at Westchester. The company is allowed until Aug. 2, 1911, to complete its four tracks from the city line to 174th St., and until Aug. 2, 1913, for the construction from 174th St. to the Harlem River. Noted on Nov. 5.

OGDENSBURG, N. Y.—Plans are under consideration, it is said, by J. Wesley Allison, of Morrisburg, Ont., and Leslie Shaw, former Secretary of the Treasury, for the construction of an electric railway, about 75 miles in length, from Ottawa, Ont., to a point on the New York & Ottawa Ry., giving connection with Morrisburg on the St. Lawrence River.

ALTOONA, PA.—The Merchants' Association is interested in the promotion of an electric railway to be built between Altoona and Bedford. F. W. Patterson, 331 Fourth Ave., Pittsburg, is said to represent the capitalists. Noted on Nov. 5.

CHESTER, PA.—The Chester, Concordville & West Chester Electric Ry. Co. will build a line to connect Chester and West Chester. Organization has not been perfected. Joseph Shortledge, of Concordville, Pa., is the promoter. Noted on Oct. 29.

MEYERSDALE, PA.—The Pennsylvania & Maryland Street Ry. Co., which operates a line in Somerset County, Pa., and Garrett County, Md., has been granted the right to make extensions of its lines. It will reach Somerset. H. H. Manst is Gen. Mgr., French Lick, Pa.

SHAMOKIN, PA.—The Shamokin & Mt. Carmel Transit Co. plans an extension to run from Beaverville to Locust Gap, Pa. E. W. Samuel is Gen. Mgr., at Mt. Carmel, Pa.

PITTSBURG, PA.—Application will be made at Harrisburg on Dec. 1 by W. E. Kusen, A. J. Schmidt, C. August Stuetz, W. P. Heckman and J. D. G. Miller, of Pittsburg, for a charter for the Scott Township St. Ry. Co., which proposes to build a line from Scott Township, Allegany County, Pa., to a point on the Castle Shannon road.

A charter for the Banksville & West End St. Ry. Co., organized for the purpose of constructing and operating a trolley line from the Banksville road at the Allegheny County boundary line through Banksville and to a point beyond the dividing line of Union and Scott Townships, has been applied for. The applicants for the charter are W. E. Kusen, A. J. Schmidt, C. August Steutz, W. P. Heckman and J. D. C. Miller.

ATLANTA, GA.—The City Council has made a favorable report on the petition of the Georgia Securities Co. for an extension of the time limit for the beginning and completing of work by the Atlanta, Griffin & Macon Interurban Railway Co. The limit expired Oct. 24, 1908. The petition is for the limit for beginning work to be extended to Oct. 24, 1909, and for completing the work on Oct. 24, 1910. Roland Ellis, of Macon, represents the railway company. W. Jordan Massee, of Macon, is Pres. of the Georgia Securities Co., which is financing the project. Previously noted on June 11.

FAIRBURN, GA.—Frank Lederle and N. V. Perry, of Atlanta, have been appointed to make preliminary survey for the proposed Fairburn & Atlanta Ry. & Elec. Co. The line will be about 17 miles long. Noted on Sept. 10 and Nov. 19.

GARY, IND.—Gary, Hobart & Valparaiso Traction Co. has been incorporated to construct an electric interurban railway from Gary to Hobart and Valparaiso; also a street railway in Gary. Capital stock, $10,000. Incorporators: James S. Hopkins and H. W. Watkins, Chicago; Francis Y. Keaton, Aurora, Ill., and H. D. Davis, Evanston, Ill. Noted on Nov. 12.

JANESVILLE, WIS.—We are officially informed that the Cincinnati Construction Co. will not commence construction until next spring. Surveys for its proposed electric railways, which is to connect Janesville, Edgerton, Stoughton, Lake Kegonsa, Lake Waubesa and Madison, are not completed. Right-of-way is being secured. Capital has been obtained. The line will be 40 miles long. H. H. Ziegler, Columbus, Ohio, is Pres., and Joseph Ellis, Janesville, Wis., Mgr. and Ch. Engr. Noted on Aug. 13.

MINNEAPOLIS, MINN.—The Minneapolis, St. Paul, Rochester & Dubuque Electric Traction Co., has awarded a contract, it is announced, for nearly $100,000 worth of grading to H. F. BALCH CONTRACTING CO., Minneapolis. This work, which is through the hills south of Savage, is the last to make a complete roadbed from St. Paul and Minneapolis to Northfield, a distance of about 50 miles. This company is building an electric interurban railway from Minneapolis and St. Paul to Dubuque, Iowa. Noted fully on June 18.

GREAT FALLS, MONT.—G. Calvin Bower, 14 Garfield Pl., Poughkeepsie, N. Y., who was recently granted franchises for operating an electric railway between Great Falls and Choteau, Mont., 60 miles, advises us that a survey of the proposed line is being made. Right-of-way partly obtained. Capital has not been secured. Previously noted.

BILLINGS MONT.—N. S. Poole and R. E. Estep, of Billings, are interested in project to build an electric railway between Billings and Laurel. Estimated cost, $250,000.

MEXICO, MO.—The Mexico, Santa Fe & Perry Traction Co. proposes to build a line on private right-of-way from Mexico to Perry, Mo., 25 miles. Electricity or other improved power will be used. Right-of-way is secured and bids for material and construction are invited. It is also desired to place $850,000 of 6 per cent. bonds. The line may be extended to Fulton and Columbia, and later to Hannibal, Mo. Matthias Crum, of Mexico, Mo., is Pres.; S. L. Robinson, Gen. Mgr.; C. W. Gaither, Secy.; W. W. Botts, Treas.; C. C. Heizer, First Vice-Pres.; W. W. Mundy, Second Vice-Pres. Noted on April 23.

MOUNT PLEASANT, TEX.—M. C. Wolfe, Mgr., of the Red Mineral Springs Development Co., of Mount Pleasant, is interested in plan to build an interurban railroad between Red Springs, Mount Pleasant and Pittsburg, Tex., twelve miles. H. W. Peterman has a franchise to build between Mount Pleasant and Red Springs, and it is contemplated to extend this plan. Noted on July 23.

ENID, OKLA.—Hamlin Sawyer, Enid, Okla., has applied to the City Council for a franchise to build an electric railway in Enid, and east from Enid to Breckenridge, Garber, Cropper and Billings.

HOOD RIVER, ORE.—H. B. Langille, Secy. of the Upper Hood River Valley Development League, has applied to the City Council for a franchise for an electric railway in Hood River. An application has also been made by C. A. Bell, proprietor of the Mount Hood Hotel, for a franchise to construct an electric railway line.

SAN DIEGO, CAL.—The Point Loma Electric Railway, San Diego, through Charles Collier, has filed with the City Clerk, a petition for an amendment to the ordinance of the City Council granting a franchise to the company. The company now asks that the franchise grant the company authority to use electricity, gasoline or steam as a motive power, instead of electricity alone as the franchise now specifies.

HAMILTON, ONT.—Application is to be made at the next session of the Provincial Parliament for the incorporation of the Desjardins Interurban Railway Co., with the privilege to construct and operate a railway with electricity or other motive power. The routes of the road are proposed as follows: From Hamilton, by way of the towns of Dundas, Webster's Falls, Bullock's Corners, Spencer or Lindsay Creek to Galt; from a point in or near Hamilton, by way of Desjardin's canal, through Burlington Heights, along or near Stony Creek, through Waterdown to Lake Medad, between Carlyle and Kilbride, and west of the village of Campbellville, to Guelph; from a point near the proposed Hamilton and Guelph Railway, near where it crosses the Hamilton and Burlington Plains roadway to the village of Burlington. The company, besides asking power to construct any kind of a road, are asking for the privileges of building similar lines and connections with their own lines and power, to issue bonds or securities up to $25,000 per mile of the said road. The application is being made by C. Gamble, E. Brown and H. D. Gamble, K. C., 28 Scott St., Toronto.

LIGHT AND POWER PLANTS.

(denotes that this work is advertised in Engineering News.)*

WINDHAM, CONN.—The Smith & Winchester Co. has awarded the contract for the installation of the electrical work in its factory, now under construction, to the COGHLIN ELECTRIC CO., of Worcester, Mass., at $10,000.

NEW YORK, N. Y.—Bids are asked by John H. O'Brien, Comr. Water Supply, Gas and Electricity, until 2 p. m., Dec. 7, for furnishing, installing, maintaining and reserving for the use of the high pressure fire service all apparatus and equipment necessary for generating and transmitting 1,890 KW. of 3-phase, 6,600-volt, 25-cycle electric power, and furnishing and delivering this power under the terms of this contract, from Jan. 1, to Dec. 31, both inclusive, at each of the high pressure fire service pumping stations located in the Borough of Brooklyn, at Furman and Joralemon Sts., and at Willoughby and St. Edwards Sts., respectively; also for furnishing, installing, maintaining and reserving for the use of the high pressure fire service all apparatus and equipment necessary for generating and transmitting 3,250 KW. of 3-phase, 6,600-volt, 25-cycle electric power and furnishing and delivering this power, under the terms of this contract, from Jan. 1 to Dec. 31, both inclusive, at each of the high pressure fire service pumping stations located in the Borough of Manhattan, at Oliver and South Sts. and at Gansevoort and West Sts., respectively.

Bids are asked by John H. O'Brien, Comr. Dept. Water Supply, Gas and Electricity, until 2 p. m., Dec. 7, for furnishing gas and naphtha and for furnishing lamps, etc., on the streets, and so on, and for connecting, lighting, extinguishing, cleaning, repairing and maintaining the same, and also lamps belonging to the city, supplying new lamps when required, and for furnishing burners and appliances for improved system of lighting on the streets, avenues, parks and public places, from Jan. 1 to Dec. 31, both inclusive, for furnishing and maintaining electric lamps for lighting streets, avenues, public buildings, parks and public places, from Jan. 1 to Dec. 31, both inclusive; for furnishing, putting in place and maintaining 782 gas regulators, from Jan. 1 to Dec. 31, both inclusive; for furnishing steam for heating or power purposes to certain public buildings, from Jan. 1 to Dec. 31, both inclusive.

*GOWANDA, N. Y.—Bids are asked until 3 p. m., Dec. 2, by T. E. McGarr, Secy. State Comm. in Lunacy, Capitol, Albany, N. Y., for engine and dynamo and underground electric feeders from power-house to superintendent's residence and staff house at Gowanda State Homeopathic Hospital, Gowanda, N. Y. Franklin P. Ware is State Arch., Albany.

PITTSBURG, PA.—Application will be made to the Governor of Pennsylvania on Dec. 2, by Frank J. Kleber, W. J. Stewart, 307 Fifth Ave., and Albert Martin, all of Pittsburg, for a charter for the Pittsburg Manufacturers' Power Co. The company proposes to build and operate a power plant in the Pittsburg district.

PHILADELPHIA, PA.—John I. Kirk, Ch. of Bureau of Lighting, Dept. of Public Works, writes us that there was but one bid received for lighting the naphtha lamps and for furnishing posts in the city of Philadelphia for the year 1909, that of the WELSBACH STREET LIGHTING CO. OF AMERICA, 922 Chestnut St., which was the accepted bidder at the rate of $29 per lamp per year and for furnishing posts at the rate of $9 each.

WASHINGTON, D. C.—The contract for furnishing electric lamps for the U. S. Capitol has been awarded by Elliott Woods, Supt. of the U. S. Capitol Bldg. and Grounds, to the GENERAL ELECTRIC CO., Schenectady, N. Y., at $5,725.

DANVILLE, VA.—The contract for additional equipment to be installed in the municipal electric light plant has been awarded to the ALLIS-CHALMERS CO., Milwaukee, Wis. It includes a boiler, 500-KW. turbo-generator set, etc. An appropriation of $22,000 has been made for improvements to the plant. F. Talbot is Supt. of the Water, Gas and Electric Light Dept.

RADFORD, VA.—J. J. Mott, of Radford, Pres. Radford-Carolina R. R., is interested, it is stated, in construction of a dam across the New River and development of water power for operating industrial plants. Estimated cost, $1,000,000.

CHARLOTTE, N. C.—The WESTINGHOUSE ELECTRIC & MFG. CO., Pittsburg, Pa., has been awarded contract for transformers by the Southern Power Co., of Charlotte, N. C. The total capacity is 93,000 KW. The transformers will range in size from 1,000 to 4,000 KW., and with a uniform tension of 100,000 volts. The apparatus will be used on the transmission line of the power company between Charlotte, Greensboro and Greenville, covering an area of 250 sq. miles.

SANFORD, N. C.—The Carolina Light & Power Co., formerly Central Carolina Power Co., of Raleigh, N. C., is having specifications prepared for a brick substation to be erected at Sanford, for transmitting power from water-power-electrical plant at Buckhorn Falls, on Cape Fear River, to Sanford. Power will be furnished for lighting streets of Sanford and to manufacturing plants.

HAWKINSVILLE, GA.—The city has voted to issue $15,000 of bonds for the purpose of establishing an electric light plant.

BIRMINGHAM, ALA.—The Yolande Coal & Coke Co., which has purchased 100 acres of coal lands in North Birmingham, is preparing plans to construct a power plant in connection with its coke ovens, and proposes to furnish electricity in North Birmingham and adjacent cities.

NEWCASTLE, IND.—Ambrose Petry, of Detroit, Mich., is rearranging details for building an artificial gas plant. He is the head of the Newcastle Light, Heat & Power Co., now operating in this city.

EVANSVILLE, IND.—Plans are being made by the Evansville Gas & Electric Light Co. for additions to its electric and gas systems, which will involve an expenditure of about $400,000 and will include the installation of a turbo-generator set at the electric plant at Main and Division Sts. A gas holder will be built and extensions will be made to the gas mains in the city. W. B. MacDonald is Gen. Mgr.

DECKER, IND.—Eugene Rush, of Vincennes, Ind., advises us that the Hydro Electric Co. intends to erect a water-power plant near Decker, on White River. Work on the undertaking will begin as soon as Congress has granted permission to the company the right to proceed. Mr. Rush is securing engineering data. He has measured the velocity of the stream at the site of the proposed dam at every variation of stage, this work having been carried on since the flood in January until the extreme low stage was reached last week. S. F. Cresillus, of Louisville, Ky., is Engr.

LA CROSSE, WIS.—William Neumeister and N. Haskell Withee, of La Crosse, Wis., are interested in a project to erect a water power plant, the cost of which is estimated at $250,000. Plans and specifications for the plant are being made by George Bradish, Engr., of La Crosse. The plant will be operated under the name of the La Crosse Water Power & Electric Co.

OTTAWA, KAN.—The Water and Light Board is making arrangements, it is stated, to enlarge the municipal electric light and water-works plant, plans for which are being drawn by Washburn & Son. It is proposed to enlarge the power-house and move the old Corliss engine from the old power plant. The secretary of the board was directed to secure prices on new and second-hand 100-KW. generators. J. H. Bell is Mgr.

WICHITA, KAN.—The Dodd Packing Co. has entered into a contract with the EDISON ELECTRIC CO. to supply electricity to operate its plant. The contract includes the erection of a substation at the packing house. The cost of the improvements is estimated at $50,000. The substation will be located just inside of the Dodd property and will supplant the electric plant of the packing company, the equipment of which includes five dynamos and 60 motors. A. H. Almert is Mgr. of the Edison Electric Co.

MANHATTAN, KAN.—W... advised that the MINNEAPOLIS MACHINERY CO., of ... has secured the contract ... plant for the Manhattan ... Ry. Co., of Manhattan, ... tion will include an 18 ... Twin City Corliss engine, ... horizontal return tubular ... KW., D. C. generator, ... water heater and purifier, ... etc.

GREAT FALLS, MONT.—... advised that plans are ... Charles T. Main, Engr., ... Mass., for the development ... near Great Falls. The ... is to be made at the falls ... Crooked and Rainbow, ... miles down the river from ... this point the head will be ... crib dam about 25 ft. high ... masonary head gate, and ... tures. A steel penstock ... and about 2,500 ft. long will ... intake to the power-house, ... of masonry construction ... 30,000 HP. of wheels and ... ratus. The lower develo... twelve miles below Great ... fall is about the same as ... velopment. The dam will ... construction as at Rainbow ... being 500 ft. long, and dir... the power-house. The equi... duplication of that at the up... The engineering corps is en... surveys and in the preparati... work on the cofferdams is al... It is expected to proceed w... development to completion ... sible. A portion of the power ... be used at the Boston & Mon... Great Falls, Mont. The ... transmitted to more distant ... A. Herrick is Engr.-in-Charge.

MONETT, MO.—The Monett ... Power & Ice Co. has decided to establish a ... day service, which will involve an expendi... ture of about $7,000 to put the plant in order ... to furnish the service. C. W. Copeland is Supt.

RUSSELLVILLE, ARK.—A ... brewster, C. S. Bacon and others, Pine Bluff, Ark., have taken over and reorganized Russellville Ozark Mountain Light & Traction Co. as Russellville Light & Water Co. It is planned to construct a $100,000 light and water plant, to be operated by water-power from Illinois River, four miles distant.

SHERMAN, TEX.—The city has awarded contract to the ALLIS-CHALMERS CO., Milwaukee, Wis., at $7,451, for engine, generator, exciter and switchboard for improvements to the municipal electric light plant. Contract for 150 arc lamps, regulator and transformer has been let to WESTERN ELECTRIC CO., of Dallas, Tex., and St. Louis, Mo., at $4,810. Henry Zimmerman is City Secy.

SPOKANE, WASH.—Extensive improvements and extensions are contemplated by the Washington Water Power Co., which will involve an expenditure of about $10,000,000, at the rate of $2,000,000 a year. A special meeting of the stockholders has been called for Dec. 1 to vote on the proposition to issue $15,000,000 of bonds. The capital stock of the company has been increased by $1,000,260. Henry M. Richards is Pres.

PORTLAND, ORE.—Edwin G. Amme and associates have secured water rights on the Satlam River, aggregating 10,000 HP., it is stated. It is proposed to incorporate a company under the name of the Central Oregon Power Co. for the purpose of operating a hydro-electric plant, which will furnish electrical service to Lester and Quartzville mines, Salem, Albany and adjacent towns.

ESCONDIDO, CAL.—The Directors of the Mutual Water Co. have adopted a resolution authorizing a loan of $30,000 by the Board for the installation of an electric light, heating and power plant. This will be installed half a mile below the reservoir, at which point the water has dropped 450 ft. in the run from the dam, making the development of 157 HP. possible. From this point to the city and valley, from three to seven miles westerly, the electric current will be transmitted by poles and wires.

LONG BEACH, CAL.—The Edison Electric Co., of Los Angeles, has decided to build a high-pressure gas plant on the inner harbor. Work will begin not later than Jan. 1, according to press reports. The plant will supply the coast towns between Naples and the Santa Monica Canyon, including Long Beach, San Pedro, Wilmington, Venice, Ocean Park and Santa Monica. The capacity of the plant will be 1,000,000 cu. ft. of gas and the entire cost of the plant and the pipe lines of its distributing system will cost, it is estimated, about $1,000,000. About 30 days after the construction of this plant is undertaken the Edison Co. will put up a 30,000-volt wire for the transmission of electricity from Inglewood to Long Beach, giving a direct supply and having three times the capacity of the present lines. Howard E. Smith is Mgr.

AGNEW, CAL.—Bids are asked until 4 p. m., Dec. 16, by the Board of ... anagers for the boilers, including all boiler ... om auxiliaries, steam piping, hot and ... old water piping, etc.; for the engine; for ... the generators and switchboard; for the ... nderground reinforced-concrete conduit syst... for the underground piping, electric ... nduit and electric wiring; for the main ... nd branch sewers at the Agnew State H... pital, Agnew, Cal. Sellon & Hemming ... are State Archs., 244 Kearney St., San Fr... cisco.

RENO, NEV.—W. P. Hammon ... erchants' Exchange Bldg., San Francisco, ... , has acquired control of the Truckee R... r General Electric Co. The property co... ts of two power plants on the Truckee ... er and a distributing system, transmitting ... electricity to Reno, Carson, Virginia City, ... he copper mining district at Yerington an... other sections of Nevada. It is stated th... Mr. Hammon intends to enlarge the plan... and build branches throughout the mining ... districts in Nevada, which will involve an ... xpenditure

of about $[illegible],000. Orders have been given for extension of the Reno street car lines to cover the [illegible] city.

SALT LAKE CITY, UTAH.—Louis C. Kelsey, [illegible], has submitted an estimate to the City Council of the cost of constructing a power plant at the north end of the [illegible]tonwood conduit to operate the [illegible] of the [illegible] being installed in connection with the electric [illegible]erage system. The cost of a [illegible]nt is estimated at $30,000; a 150-KW [illegible]nt could be installed for $5,000 and the 300-KW [illegible] annual cost of operating the [illegible]more. [illegible] is placed at $9,000 and of the 150-KW [illegible]nt at $10,000. 300-KW

COEUR D'ALENE, IDAHO.—The Slate [illegible] Creek [illegible] Power & Light Co. has applied for a [illegible] City Council for a 50-year franchise [illegible]city, it is stated. The company proposes to [illegible] erect an electric plant and furnish [illegible] city for lamps and motors in [illegible] to compete with the Wallace and Coeur [illegible]er Co. The company is capitalized at [illegible]0,000. D. L. Hopkins, Thomas McGowen, [illegible]lesse Freeman and William Sites are in [illegible] in the company.

MONTREAL, QUE.—The HILL ELECTRIC MFG. Co. [illegible] have been awarded the contract for the main [illegible]hboard and panel-boards for the new [illegible]man Building, McGill University.

WINNIPEG, MAN.—The city has let contract [illegible] connection with the power plant to R. & H. [illegible]cLEOD, of Winnipeg, for the construction [illegible] of a system between Point-du-Bois and [illegible] Du Bonnett at a cost of $6,000. The distance is approximately 24 miles, and the above figure includes supplying and erection of [illegible]edar poles and all other material. Work is to commence on the system at once.

MEXICO CITY, MEX.—The following applications have been made to the Mexican Government recently for concessions to install hydro-electric plants: Mariano Alcerreca and Jose Jijar y Harro, to erect a plant on the Santa Cruz and San Francisco creeks near El Monte; Guillermo Brockman, to erect a plant on the Turbio River, State of Guanajuato; Tezuitlan Mining & Smelting Co., to erect a plant on the Sola River, State of Oaxaca; Isidro Medina, to erect a plant on the Ameca River, near Ameca, State of Jalisco; General Mariano Ruiz, to erect a plant on the Alica River, Territory of Tepic; Gill S. Peyton, to erect a plant on the Lerma River, State of Jalisco; Armado I. Santa Cruz, to erect a plant on the Huitzilapam River, State of Puebla.

BRIDGES.

(denotes that this work is advertised in Engineering News.)*

BOSTON, MASS.—The WALWORTH CONSTRUCTION & SUPPLY CO., 100 Pearl St., Boston, has been awarded the contract for repairing the Congress St., drawbridge over Fort Point Channel at $3,830. William Jackson is City Engr.

HARTFORD, CONN.—The Railroad Commissioners have approved the specifications for the new bridge on the trolley line over the Central New England Ry. tracks near the Bloomfield station. The bridge is to be of 80-ft. span, 6 ft. 6 ins. wide and 21¾ ft. in the clear.

*MAMARONECK, N. Y.—Bids are asked by the Board of Trustees until 8.30 p. m., Dec. 9, for the construction of a concrete arch bridge and the grading and otherwise improving 750 lin. ft. of Ward Ave. An approximate estimate of the work to be done is as follows: 3,000 cu. yds. excavation for grading street, one 35-ft. span reinforced concrete arch bridge, 50 ft. in width. Charles W. Buckter is Clk. Bd.

ROCHESTER, N. Y.—Bids are asked by F. C. Stevens, Supt. Pub. Wks., until noon, Dec. 3, for the construction of a lift bridge over the Erie canal at Allen St., and the construction of a similar bridge over the canal at Lyell Ave., Rochester. Frederick Skene is State Engr.

LONG ISLAND CITY (L. I.), N. Y.—Work will commence soon on the construction of the steel frame of the viaduct which will be built across the Long Island R. R. tracks in Thompson Ave., Long Island City.

NEWARK, N. J.—Plans for the construction of the Elwood Ave. bridge across the Passaic River to Kearny, N. J., will soon be prepared by the County Engineers of Essex and Hudson Counties.

TACOMA PARK (Washington post-office), D. C.—The contract for the construction of a bridge across Sligo Stream at Carroll Ave. has been awarded by the town to the WASHINGTON SANITARIUM ASSOCIATION, Tacoma Park, at $11,944. Bids were opened on Nov. 11. Benjamin G. Davis is Town Clk.

*LYNCHBURG, VA. — The OWEGO BRIDGE CO., Owego, N. Y., and 52 Benbow Arcade, Greensboro, N. C., the lowest bidder, has been awarded the contract for repairs to the Rivermont viaduct, the work consisting of placing stringers under car tracks, about 100 tons, lacing top chords, etc. List of bidders noted on Nov. 5.

SAVANNAH, GA.—The Seaboard Air Line Ry. Co., E. A. Frink, Bridge Engr., Portsmouth, Va., has submitted plans to U. S. War Department, for a lift bridge to replace its present structure over the river here.

GULFPORT, MISS.—Bids will be received until Dec. 7 by the Clerk of the County Board for constructing a bridge across Hurricane Creek on the Airey and Ramsay Roads.

VICKSBURG, MISS.—Bids will be received by the Chancery Clerk of Warren County, Vicksburg, until Dec. 7 for building four bridges. J. D. Laughlin is Clk.

CLEVELAND, OHIO.—Bids are to be asked at once for the construction of the Harvard-Denison bridge, for which a $450,000 bond issue has been voted. R. W. Hoffman is City Engr.

VALPARAISO, IND.—Bids will be received until Dec. 7 by S. P. Corboy, County Audr., for the construction of the following steel bridges: One 40-ft. span on concrete, one 60-ft. span on tubes, one 100-ft. span on tubes, and two 90-ft. spans on tubes. G. F. Stinchgeld is County Surv.

PEORIA, ILL.—R. H. Johnson, Gen. Mgr., Peoria & Pekin Union Ry. Co. has announced that the company has approved plans submitted for a new steel double-track bridge across the Illinois River at Peoria. Construction will begin early in the spring. The plans call for an expenditure of $525,000.

CHICAGO, ILL.—Bids were opened on Nov. 10 at the office of the Board of Public Works for the construction of a bridge over the Illinois and Michigan Canal at Ashland Ave. The contract for the substructure was awarded to JOHN O'BRIEN, 75 Clark St., at $5,100, and for superstructure, to the MILWAUKEE BRIDGE CO., of Milwaukee, Wis., at $11,000.

*CHICAGO, ILL.—Bids were received as follows on Nov. 18 by the Clerk of the Sanitary District of Chicago for building a reinforced-concrete dam, and for performing certain collateral bridge work. The work includes the excavation of about 210,000 cu. yds. of earth, the building of a reinforced-concrete dam on the North Branch of the Chicago River, the construction of substructures and the erection only of the superstructures of highway bridges at Foster Ave., Argyle St. and Lawrence Ave.: American Engineering & Construction Co., 112 Clark St., Chicago, $76,699; George Donnersberger, Chicago, $85,165; John W. Page, Chicago, $88,720; James O. Heyworth, Railway Exchange Bldg., Chicago, $89,277; Great Lakes Dredge & Dock Co., Commerce Bldg., Chicago, $106,269; National Construction Co., Tacoma Bldg., Chicago, $111,950; Standard Construction Co., First National Bank Bldg., Chicago, $119,368.

MILWAUKEE, WIS.—The Board of Public Works has estimated the cost of reinforcing and repairing the 16th St. viaduct at $65,000. C. J. Poetsch is City Engr.

MARINETTE, WIS.—The City Engineer is preparing detailed plans for an approach to the lower drawbridge to take the place of the present structure. The plans will provide for a steel supported incline. Two sections of steel stringers and supports will be run from the end of the last span of bridge and the remainder of the approach will be completed by filling.

COUNCIL BLUFFS, IOWA.—The contract for the construction of bridges in Pottawattamie County has been awarded by the Board of Supervisors to W. M. LANA, of Harlan, Iowa, for the year 1900 at $5.75 per lin. ft.

DULUTH, MINN.—The lowest bid received by the Board of Public Works for constructing the concrete culvert and fill on Grand Ave., near Mathews St., has been submitted by Gulbranson Bros., at $7,337.

LEAVENWORTH, KAN.—The citizens have voted to construct three concrete bridges in Leavenworth County.

WICHITA, KAN.—Bids are asked until Dec. 5 by the County Clerk, for erecting bridges as follows: One 60-ft. pile bridge over Chisholm Creek, one 16-ft. pile bridge over the same stream, one 60-ft. steel bridge in Morton Township over Spring Creek, one 400-ft. pile bridge over the Ninnescah, in Viola Township, one 300-ft. pile bridge over the Ninnescah in Morton Township, and an 80-ft. pile bridge over the Cowskin in Waco Township.

OMAHA, NEB.—The Park Board will erect a concrete arch viaduct at the Deer Park intersection of 16th St. and the Boulevard.

*KANSAS CITY, MO.—The contract for constructing the reinforced concrete approach to the Main St. viaduct, bids opened Nov. 6, has been awarded by the Commercial Improvement Co. to A. M. BLODGETT CONSTRUCTION CO., of Kansas City.

MARIANNA, ARK.—We are officially advised that bids were received as follows on Nov. 18 by the County Court Clerk for the construction of a steel highway bridge, 540 ft. long, across the L'Anguille River, at Marianna, the work requiring 244,600 lbs. of steel, 28,140 ft. of white oak lumber, 179.2 cu. yds. of concrete and 44 piles, 35 ft. × 12 ins.: Illinois Steel Bridge Co., Jackson, Ill., $10,944; Midland Bridge Co., Kansas City, Mo., $12,494; Virginia Bridge & Iron Co., Roanoke, Va., $13,330; Joliet Bridge & Iron Co., Joliet, Ill., $11,350; Moravia Construction Co., Dallas, Tex., $11,270; Central States Bridge Co., Indianapolis, Ind., $11,978; Magden & Sheely, Des Moines, Iowa, $13,225; Memphis Bridge Co., Memphis, Tenn., $11,479; Continental Bridge Co., Chicago, Ill., $11,952; Monarch Construction Co., Omaha, Neb., $12,480; VINCENNES BRIDGE CO., Vincennes, Ind., $10,807 (awarded contract); Southern Bridge Co., Birmingham, Ala., $12,244; Kansas City Bridge Co., Kansas City, Mo., $12,994. H. N. Pharr is Consult. Engr., 216 Randolph Bldg., Memphis, Tenn.

*AUSTIN, TEX.—The Travis County Commissioners on Nov. 15 awarded the contract to WILLIAM P. CARMICHAEL CONSTRUCTION CO., Fulierton Bldg., St. Louis, Mo., at $176,490 for the construction of the bridge across Colorado River at foot of Congress Ave., the structure to be 942 ft. long, 48 ft. wide and constructed of steel and reinforced concrete. Waddell & Harrington, Kansas City, Mo., are Consult. Engrs. John W. Hornsby is County Judge. Noted last week.

EL PASO, TEX.—The El Paso County Commissioners have awarded the contract to the EL PASO BRIDGE & IRON CO., El Paso, at $5,950 for the construction of the steel bridges across the Rio Grande River at Courchesne and Canutillo; six spans, each 40 ft. long.

BROWNSVILLE, TEX.—The St. Louis, Brownsville & Mexico Ry., J. N. Miller, Gen. Mgr., Kingsville, Tex., has practically completed plans for the construction of an international bridge across the Rio Grande River at Brownsville.

WAITSBURG, WASH.—The City Council has rejected all bids for the Main St. bridge. New bids are being asked.

PARKER (Toppenish post-office), WASH.—The BURRELL BRIDGE & CONSTRUCTION CO., of Seattle, has been awarded the contract for construction work on the new bridge to be built across the Yakima River at Parker at about $3,346. The county will supply the material for the bridge span.

SUMNER, WASH.—Bids will be received by the Board of County Commissioners of Pierce County until 11 a. m., Dec. 24, for the construction of a bridge at Sumner, to consist of a 180-ft. steel and iron through span, resting on cylinder piers with a pile trestle approach 200 ft. long on the north side and a 20-ft. approach on the south side, conforming to grade, etc.

PETALUMA, CAL.—WILLIAM L. CALL has secured the contract for constructing a bridge over Green Valley Creek for the county.

CENTERVILLE, CAL.—We are officially advised that BRUCE & WELLS, Oakland, Cal., were awarded the contract on Nov. 16, by John P. Cook, County Clk., for replanking the trestle bridge on the road from Alvarado to Centerville, at $3,324.

OTTAWA, ONT.—The contract for the concrete work and filling for the widening of the Somerset St. bridge has been awarded by the Ottawa Electric Co. to T. McLAUGHLIN, Ottawa. The steel superstructure will be erected by the DOMINION BRIDGE CO. The new work will give an additional width to the bridge of 16 ft. Estimated cost, about $14,000.

REVELSTOKE, B. C.—The Government engineers are preparing plans for the new bridge to be built over the Columbia River at Revelstoke. Estimated cost, $40,000.

BUILDINGS.

(denotes that this work is advertised in Engineering News.)*

LYNN, MASS.—We are officially advised that competitive plans and specifications are being considered by the Board of School Commissioners, Charles H. Speer, Secy., for a 3-story brick school to contain 51,750 sq. ft. and to cost $85,000.

ATTLEBORO, MASS.—The plans of Cooper & Bailey, Archs., 60 Congress St., Boston, Mass., have been accepted for a school building to cost $55,000.

BOSTON, MASS.—It is intended to erect a school for girls, to be known as the Winsor School, at Longwood. The site lies on both sides of Berners Park, between Longwood Ave. and Riverside Drive. On the east the school will have a frontage on Bellevue St., and on the west on the Riverway Drive of the Boston Park system. The main entrance will be on the north on a new street, a continuation of Short St. The estimated cost of the school, including land, buildings, furniture, equipment and architect's commissions, is about $300,000. The officers of the Winsor School are Charles S. Hamlin, Pres.; Charles P. Curtis, Secy., and Charles W. Hubbard, Treas. Charles William Eliot, Pres. of Harvard University, is Chn. of the Executive Com. Mary P. Winsor will be Principal.

LYNN, MASS.—We are officially advised that plans have been prepared by Josephine Wright Chapman, 11 West Eighth St., New York, N. Y., for a 3-story woman's clubhouse, 68 × 80 ft., to be erected on Broad St., Lynn, at the corner of Nahant St. The building will be erected for the Lynn Women's Club Corporation at a cost of $50,000. The structure will have a high basement. Estimates are being taken for the work.

NEW BRITAIN, CONN.—W. P. Crabtree, Arch., Booth's Block, has prepared plans for the proposed building for the Children's Home, same to be 240 × 50 ft.

TORRINGTON, CONN.—Bids are asked until Nov. 30, by W. W. Bierce, Chn. School Com., for erecting the East Side School building.

NEW BEDFORD, CONN.—We are officially advised that on Nov. 18, 14 sketches for the proposed high school were received. The City Council Committee on City Property has decided to meet each architect and allow him to explain his plans, before deciding upon acceptance.

LONG BEACH (L. I.), N. Y.—We are officially advised that WESTINGHOUSE, CHURCH, KERR & CO., 10 Bridge St., New York, have secured the general contract to construct the proposed hotel at Long Beach, for the Nassau Hotel Co., for which Lewis R. Kaufman, Arch., 7 West 38th St., New York, has prepared the plans. The building will front 300 ft. on the board walk, the center portion of the ground floor being planned for stores. The eastern end will have the main entrance to the hotel and will contain a lobby opening on three sides overlooking the ocean. The western end will be occupied by the main dining-room, with a seating capacity of over 1,000 people, and there will be 300 rooms. J. L. de Saules, of New York, and Henry L. Gillespie, of T. A. Gillespie & Co., Westinghouse Bldg., Pittsburg, Pa., represent the hotel company.

COLLINS, N. Y.—Plans and specifications have been filed for the Erie R. R. Co. with the Public Service Commission, Second District, for a passenger station to be built at Collins, Erie County. The present building is to be moved and converted into a freight house, and its site will be used for the new structure. F. L. Stuart, New York, is Ch. Engr.

NEW YORK, N. Y.—We are officially advised that the GEORGE A. FULLER CO., Fuller Bldg., has the general contract to erect an apartment house to occupy the block bounded by 86th and 87th Sts., Broadway and Amsterdam Ave. The building is to be twelve stories high, of the Renaissance

NEW YORK, N. Y.—Bids are asked by C. B. Snyder, Supt. of School Bldgs., Dept. of Education, until 3.30 p. m., Dec. 7, for the erection of outside stone stairs, etc., at Public School No. 28, Anthony and Tremont Aves. and Mount Hope Pl., Boro. of the Bronx; for installing heating apparatus in the Nautical School, on the recreation pier at the foot of East 24th St., Boro. of Manhattan; for glass to be furnished to the various schools in the Boroughs of Queens and Brooklyn.

type, built of gray limestone at the first two stories and brick with terra cotta trimmings above. It will be 150 ft. high, 350 ft. long and 200 ft. wide, and is to contain 175 suites of apartments, each 50 ft. deep and containing from nine to fourteen rooms, finished in mahogany and other ornamental hardwoods, and decorated in the style of Louis XVI. The main entrance will be at the 86th St. front, finished with a double driveway leading to an interior court. This court will be 250 ft. long and 100 ft. wide, and will have grass plots and fountains. The driveway will be paved with oak blocks to deaden sound. The building is to cost $1,800,000. H. Hobart Weekes, 111 Fifth Ave., is Arch.

Plans have been filed for enlarging the 9-story office building of the North River Insurance Co., 93 to 97 William St., by adding five stories, the improvements being made for the William St. Offices, as owner. Andrew B. Newcombe, Pres., and at a cost of $80,000. Frank H. Quimby is Arch.

The Bronx Benevolent and Protective Order of Elks, No. 871, has purchased property at the corner of the Grand Boulevard and Concourse and Burnside Ave., a plot 50 × 102 ft., and will begin immediately the erection of a club-house costing between $75,000 and $100,000. Seymour Mork is Chn. Bldg. Com., the other members being Peter J. Meehan, David C. Pierce, Patrick Henry Clune and Charles Ohmels. No building contracts have been signed.

NEW YORK, N. Y.—We are officially advised that plans have been completed by J. E. Scharsmith, Arch., 1 Madison Ave., for a 6-story apartment house which the 164th St. Co., 1 Madison Ave., will erect at St. Nicholas Ave., 164th and 163d Sts., to cost about $110,000. The building will be 53.9½ × 106 ×91.0½ × 90 ft. and will be constructed of brick and stone. Estimates will be taken at once.

Plans have been filed by Schaefer & Jaeger, Archs., 461 Tremont Ave., the Bronx, for erecting a 5-story brick apartment house, 50 × 88 ft., on 154th St., west of Eltod Ave., the Bronx, for Benjamin Bereson, 415 Brook Ave.

The two 4-story and basement dwellings at the southeast corner of Madison Ave. and 80th St. are to be enlarged. Two more stories will be added, the basement made over into stores, and the interior made into two suites of apartments for two families in each house, each suite including two of the present floors. The improvements are to be made for the Gray Realty Co. at a cost of $75,000, and from drawings by Harry Allan Jacobs, Arch., 320 Fifth Ave., New York.

NEW YORK, N. Y.—We are officially advised that Charles E. McManus, 45 East 42d St., is taking estimates for an 8-story brick and stone apartment house, to be erected on 85th St., east of Riverside Drive. The structure will be 75 × 87.2 ft., and will cost $200,000. Neville & Bagge, 217 West 125th St., are Archs.

Plans for a $400,000 apartment building, to overlook Gramercy Park from the east side, have been completed by J. Riely Gordon, Arch., 244 Fifth Ave.

NEW YORK, N. Y.—Bids are asked until 2:30 p. m., Dec. 7, by Robert W. Hebberd, Comr. of Dept. of Public Charities, for providing all labor and materials required for the cooking service equipment (including refrigerators), gas and electric fixtures and fitting up (other than for closets and linen and blanket rooms), and all other work as set forth in the drawings and specifications for the erection and entire completion of a nurses' home for the Metropolitan Hospital Blackwell's Island, the City of New York.

Bids are asked by Nicholas J. Hayes, Fire Comr., until 10:30 a. m., Dec. 8, for furnishing all the labor and materials required for additions and alterations to the quarters of Hose Company 3, north side of Bradman Ave., west of Henry St., Jamaica; additions and alterations to the quarters of Hose Company 4, east side of Rockaway Road, south of Fulton St., Jamaica; additions and alterations to the quarters of Hose Company 5, west side of John St., north of Charles Pl., Jamaica; additions and alterations to the quarters of Hose Company 6, west side of Herriman Ave., north of Fulton St., Jamaica; additions and alterations to the quarters of Hose Company 7, east side of Orchard St., south of Shelton Ave., Jamaica; additions and alterations to the quarters of Hook and Ladder Company 75, Spruce St., north of Atlantic Ave., Richmond Hill.

JERSEY CITY, N. J.—Bids are asked until Dec. 23 by the Board of Education for constructing Public School No. 32. Cost, $300,000. John T. Rowland, Jr., 15 Exchange Pl., Jersey City, is Arch.

SEA BRIGHT, N. J.—Watson, Huckel & Co., Archs., 1211 Walnut St., Philadelphia, have prepared preliminary plans for a 4-story hotel, to be built at Sea Bright. Cost, $500,000.

PASSAIC, N. J.—Bids are asked until Dec. 19 by the Board of Education for constructing a 3-story high school building. Estimated cost, $225,000. Seymore & Paul A. Davis, 1000 Chestnut St., Philadelphia, are Archs.

NEWARK, N. J.—Operations are to be started on May 1 for the construction of the proposed Prudential Building annex at Halsey and Academy Sts., Newark. CHARLES R. HEDDEN, 22 Clinton St., Newark, has the general contract. Seventeen buildings on the site will be razed. There will be an assembly room in the center of the structure above the first story. This room will be 50 ft. in width by 90 ft. in length; of ornate design in plaster and wood, following Gothic lines. GEORGE BROWN & CO., 270 Passaic

St., Branch Brook, Newark, have contract for 150,000 ft. of cut stone. The work of getting out the stone will be started at once in order to have the material ready by May 1. A contract for 8,000,000 brick has been awarded to the ROSE BRICK CO., 640 West 52d St., New York, and another for 40,000 bbls. of Portland cement, to the NORTHAMPTON PIOTLAND CEMENT CO., 165 Broadway, New York. Estimates are now being received for supplying 5,000 tons of structural steel; and contracts for this material will be given out at an early date. There will be 16 of the traction type of electric elevators installed, to be operated by machinery located at the top of the shafts, instead of at the bottom as at present.

PHILADELPHIA, PA.—The following bids were received at the Bureau of Yards and Docks, Navy Dept., Washington, D. C., for additions and alterations in the U. S. Naval Hospital, Philadelphia: George A. Fuller Co., Fuller Bldg., New York, $167,000 (if elevator omitted deduct $12,000); George A. Glenn & Co., 930 North Eighth St., Philadelphia, $159,143; Henery E. Eaton, 1224 Arch St., Philadelphia, $161,457; Cramp & Co., Commonwealth Bldg., Philadelphia, $162,000; Edward F. Fonder, Land Title Bldg., Philadelphia, $183,777; Edward Fay & Son, 1521 Ranstead St., Philadelphia, $153,990.

Stearn & Castor, Archs., Stephen Girard Bldg., have awarded contract to JOHN R. WIGGINS & CO., Heed Bldg., for remodeling building into club house and cathedral for the Scottish Rites Consistory, F. & A. M. Cost, $75,000.

Work will be started soon rebuilding the Eagles' clubhouse at 1334 Spring Garden St., which was destroyed by fire a year ago. Richard C. Loos, Arch., 1017 Chestnut St., has awarded a contract for the work to ROBBINS & CO. The cost will be about $50,000.

PHILADELPHIA, PA.—We are officially advised that Sauer & Hahn, Archs., are preparing plans for an 11-story building, 45 × 134 ft., for the People's Trust Co. The building will cost $150,000; equipment, $30,000. The construction will be fireproof and of concrete, granite and terra cotta. Part of the equipment needed follows: Elevators, power plant, sprinklers, electric machinery, bank fixtures and vaults, steam heating. Contracts will be let in February. Noted on Nov. 12.

Louis Magaziner and Newman & Harris, Archs., Land Title Annex, have prepared plans for an addition for the Mt. Sinai Hospital. Jacob Lit is interested. Cost, $50,000.

Plans were decided upon at a recent meeting of the Property Committee of the Board of Education for the erection of an elementary school. The building will be constructed in the vicinity of Ninth and Tucker Sts. See item in issue of Nov. 19.

Thomas P. Hunter, who recently bought the Wallace property at Haverford has commissioned Horace Trumbauer, Arch., Land Title Bldg., to prepare plans for a residence and stable to be built on the property at a cost of $100,000. The present buildings will be demolished. The plans call for a 3-story stone and frame building of elaborate design.

PHILADELPHIA, PA.—Horace Trumbauer, Land Title Bldg., has about completed plans for the 6-story addition to the Union League Clubhouse. Estimated cost, $600,000.

Charles L. Brown & Co., 217 South Broad St., have secured the site for a building to be erected early next year, at the corner of 13th and Arch Sts. at a cost of upward of $100,000. The structure will have a frontage of 64 ft. and a depth along 13th St. of 101 ft. It will be constructed of reinforced concrete and will be six stories high, with stores on the first floor and lofts above.

Announcement has been made that contractors will be invited to estimate on the plans for the new building for the Curtis Publishing Co. The list of contractors who will be asked to estimate has not been made up and will not be until the plans are nearly completed, which will be on Dec. 15 or a little later. By Jan. 1, it is expected the contractors will have the drawings on their boards. The Curtis Building will consist of three sections: The editorial and business on Sixth St., between Walnut and Sansom Sts., the mechanical on Walnut St., west of Sixth, and the boiler-house on Sansom St., West of Sixth. The cost will exceed $3,000,000 it is stated. Edgar W. Seeler, Real Estate Trust Bldg., is Arch., and Frank C. Roberts & Co., same address, are Engrs.

Permits for the erection of 82 houses and a store, at a total cost of $120,000, have been granted James F. Maguire, Fidelity Bldg. The houses will be constructed of brick and stone and will be two stories high. They will be erected in the vicinity of Third and Ontario Sts.

BALTIMORE, MD.—The Baltimore "Sun" states that the Terminal Warehouse Co. will build a 4-story addition to the warehouse at Monument and Constitution Sts., to cost about $120,000. With the completion of this building the warehouse will be more than doubled in size. It will be of steel frame construction, with fireproof floors and partitions. The site fronts 150 ft., with a depth of 170 ft. The building will be according to plans prepared by Owens & Sisco, Archs., Continental Trust Bldg., Baltimore. The work will commence shortly. The terminal Warehouse Co. is affiliated with the Pennsylvania R. R. Co. interests. The new warehouse will have three electric elevators. It will be planned to store machinery and other heavy goods. Local contractors and builders are invited to estimate.

Baldwin & Pennington, Archs., Professional Bldg., have plans for improvements and additions to the Fidelity and Deposit Trust Co. building. Cost, $75,000.

WASHINGTON, D. C.—Bids were received as follows Nov. 21 at the office of the Superintendent of Construction of the National Museum building, Washington, for furnishing and installing the white marble wainscotting, partitions and tiling of halls and lavatories and the Tennessee marble tiling, stairs, strings and bases, etc.: Davis Marble Co., Flatiron Bldg., New York, $41,700; Batterson & Eisele, Times Bldg., New York, $51,930; A. Klauber & Son, New York, $52,648; William Bradley & Son, 90 West St., New York, $38,123; Vermont Marble Co., Proctor, Vt., $36,320, $36,720, $37,870.

Bids are asked until 2 p. m., Nov. 30, by Bernard R. Green, Supt. of Construction, National Museum, for furnishing and delivering the Georgia pine dressed flooring lumber required for the new building for the National Museum in this city.

Harry B. Parker, 1001 Park Road, N. W., will erect an apartment house at 16th St. and Park Road, Mt. Pleasant, on a site, 85 × 197 ft. The building will have five stories and basement of stone and brick, steel frame with exterior of French renaissance style, tower at corner, roof garden. Floors and main partitions are to be fireproof. It will contain 30 suites of apartments of from three to six rooms, finished in hardwood, mission style. Basement is to contain hotel facilities, including dining-room, buffet, etc. The halls will have tile flooring and marble trimmings, steam heat, two elevators. Estimated cost, $225,000. Nicholas T. Haller & Co., Corcoran Bldg., Washington, is Arch. Contract has been let to BLAKELY & BARRETT.

RICHMOND, VA.—Bids are asked by the Committee on Grounds and Buildings at the office of H. P. Peck, Building Inspector, until 6 p. m., Dec. 3, for the construction of a market and armory building. Averill, Hall & Adams, 719 Union Trust Bldg., Washington, D. C., are Archs.

NEWBURN, N. C.—James Knox Taylor, Superv. Arch., Treasury Dept., Washington, D. C., has rejected all bids for the construction of a post-office building at Newburn, N. C., as being in excess of the amount appropriated. Readvertisement will be issued.

CHARLESTON, N. C.—The lowest bid received on Nov. 21 by the Bureau of Yards and Docks, Navy Dept., Washington, D. C., for two electric freight elevators, Navy Yard, Charleston, was that of John B. Alt, 342 North Holliday St., Baltimore, Md., at $7,145 and $6,235.

ATLANTA, GA.—A. Ten Eyck Brown has plans for a theater and office building for E. P. Ansley and associates, it is stated. Cost, $170,000.

MARIETTA, GA.—James Knox Taylor, Superv. Arch., Treasury Dept., Washington, D. C., has awarded to the WILMARTH BUILDING CO., 1170 Broadway, New York, contract for the construction of a post-office at Marietta, Ga., at $42,549.

PENSACOLA, FLA.—We are officially advised that W. L. Stoddart, Arch., 31 Union Sq., New York, N. Y., will receive estimates until about Dec. 15, for erecting an 8-story hotel, 100 × 140 ft., for the Pensacola Hotel Co. The building will be fireproof, of concrete frame construction, and will cost $250,000. Plans and specifications will be ready for estimates after Nov. 30.

NASHVILLE, TENN.—Mowbray & Uffinger, Archs., 94 Liberty St., New York, are preparing plans for a 5-story bank and office building for the Union Bank & Trust Co., Nashville. Cost, $150,000.

GREENVILLE, TENN.—James Knox Taylor, Superv. Arch., Treasury Dept., Washington, D. C., has awarded contract for the construction of a post-office at Greenville, Tenn., to PELL & AINSWORTH, of Waco, Tex., at $53,250.

COVINGTON, KY.—Bids are asked by the Board of Library Trustees of Covington, until noon, Dec. 7, for alterations to the auditorium of the Covington Library building. John J. Craig is Pres. Bd. Trustees; Dittoe & Wisenall, Blymyer Bldg., Cincinnati, Ohio, are Archs.

LEXINGTON, KY.—The I. O. O. F. has awarded contracts to FRANK CORBIN, Lexington, for erection of an addition to the Widows and Orphans' Home, and to THOMAS SHEEHAN, Lexington, for the foundation. The main building will be three stories and will connect with building two stories and basement. An additional building will be erected for installing heating and electric-light plants. Cost, about $55,000. H. L. Rowe & Co., Lexington, are Archs.

CINCINNATI, OHIO.—Bids are asked until noon, Dec. 15, by the Board of Education for furnishing all materials and doing work necessary to complete the new school building on the Eleventh District School lot, located on the west side of Linn St., from Clinton St. to Armory Ave., in the city of Cincinnati. E. H. Dornette, Pickering Bldg., is Arch.; C. W. Handman is Business Mgr., Bd. of Education.

CLEVELAND, OHIO.—W. P. Ginther, of Akron, Ohio, is preparing revised plans and will receive bids for a 2-story brick addition to hospital and chapel for St. Ann's Orphan Asylum, Woodland, Cleveland. The new building will be larger than previously planned and will cost $50,000.

EAST LIVERPOOL, OHIO.—The proposition to issue $69,000 of bonds for the erection of school buildings has been carried. The Board of Education is arranging to sell the bonds, purchase sites and have plans prepared for two 8-room and one 4-room school buildings. Competitive plans and specifications will be received until Dec. 20. W. E. Dunlap is Clerk.

FORT BENJAMIN HARRISON, (Lawrence post-office), IND.—Bids are asked until 2 p. m., Dec. 8, by Capt. G. Maury Cralle, Constr. Q. M., for the construction, plumbing and electric wiring of one stable for 78 animals at this post.

*NILES, MICH.—Bids are asked until 3 p. m., Jan. 5, by James Knox Taylor, Superv. Arch., Treasury Dept., Washington, D. C., for the construction (including plumbing, gas piping, heating apparatus, electric conduits and wiring) of the U. S. post-office at Niles.

SAULT STE. MARIE, MICH.—Bids are asked by James Knox Taylor, Superv. Arch., Treasury Dept., Washington, D. C., until 3 p. m., Jan. 4, for the construction complete (except elevator) of the U. S. post-office at Sault Sainte Marie.

ANN ARBOR, MICH.—Plans have been completed and funds subscribed for the erection of a $300,000 dormitory in Ann Arbor. The dormitory will be a 6-story building at Williams and Maynard Sts., capable of housing 250 to 300 men. The commons will be a 1-story building with a capacity for boarding from 900 to 1,000 students. The land has been acquired and the plan has been approved by the University Senate.

MONMOUTH, ILL.—Whitfield & King, Archs., 160 Fifth Ave., New York, have let general contract to A. C. PHILIPSON, Monmouth, to erect a 2-story and basement science building for Monmouth College, Monmouth. Cost, $50,000.

ALTON, ILL.—Bids are asked until 3 p. m., Dec. 29, by James Knox Taylor, Superv. Arch., Treasury Dept., Washington, D. C., for the construction (including plumbing, gas piping, heating apparatus, electric conduits and wiring) of the U. S. post-office at Alton, Ill.

OAK PARK, ILL.—Bids are asked by the Board of Cook County Commissioners, at office of William McLaren, Supt. of Public Service, Court-House, Chicago, until 1.30 p. m., Dec. 7 (extension of time), for the erection of the county infirmary at Oak Forest. William Busse is Pres.; Holabird & Roche, Monadnock Block, are Archs.

CHICAGO, ILL.—Mrs. Ida A. Richardson, of New Orleans, La., will erect at 192 West Jackson Boulevard a mercantile building to cost $150,000. The building will be six stories high and will front 75 ft., with a depth of 165 ft. It will be of pressed brick and stone and will be equipped with modern machinery.

DES MOINES, IOWA.—B. F. Williams, Pres. of the Capital City Commercial College, has announced that a new building will be erected for the use of the college to cost about $60,000. The location has been chosen.

NEW ULM, MINN.—Bids were received as follows Nov. 18, at the office of James Knox Taylor, Superv. Arch., Treasury Dept., Washington, D. C., for the construction of a post-office building at New Ulm, Minn.: Stewart & Hager Co., Janesville, Wis., $42,950; Otto Tappe, New Ulm, Minn., $43,858; Wieland & Segeman, New Ulm, Minn., $46,000; General Construction Co., Milwaukee, Wis., $54,600; C. F. Kaiser and August Puhlman, New Ulm, Minn., $43,839; J. W. Miller, St. Paul, Minn., $43,570; Northern Construction Co., $48,000; George R. Kieche, Madison, Wis., $48,239; J. M. Hennessey Construction Co., St. Paul, Minn., $48,830.

ST. PAUL, MINN.—James Knox Taylor, Superv. Arch., Treasury Dept., Washington, D. C., has awarded contract for the construction of the tower for the St. Paul, Minn., post-office to P. M. HENNESSEY CONSTRUCTION CO., New York Life Bldg., St. Paul, Minn., at $102,445. Time, March 31, 1910.

DULUTH, MINN.—Bids were received as follows Nov. 23 at the office of James Knox Taylor, Superv. Arch., Treasury Dept., Washington, D. C., for the installation of electric elevators at the Duluth post-office: Llewellyn Iron Works, Los Angeles, Cal., $5,950; Otis Elevator Co., 17 Battery Pl., New York, $4,391; Marine Engine & Machine Co., New York, $5,747.

*HOT SPRINGS, S. DAK.—Bids are asked by W. A. Turner, Treas., Battle Mountain Sanitarium, N. H. D. V. S., Hot Springs, Fall River County, South Dakota, until noon, Dec. 21, for furnishing all necessary labor and materials for completing the final installation of the hydrotherapeutic equipment in the basement of Ward No. 2, Battle Mountain Sanitarium, N. H. D. V. S., Hot Springs.

RAWLINS, WYO.—Bids were received as follows Nov. 19, at the office of James Knox Taylor, Supervising Arch., Treasury Dept., Washington, D. C., for the construction of a post-office at Rawlins, Wyo.: S. B. Morrison, Denver, Colo., $85,500; Northwestern Construction Co., Wahpeton, N. Dak., $84,000.

ST. LOUIS, MO.—R. G. Kirsch, Arch., 717½ Chestnut St., has prepared plans for a 2-story hospital building for the Association Hospital. Cost, $60,000.

The St. Louis "Republic" states that preparations have been made for a mercantile building to be erected between 15th and 18th Sts. and Olive St. and Washington Ave., by the Mississippi Valley Trust Co. It will stand on the corner of 15th St. and Washington Ave., extending through to Lucas Ave., will be ten stories high and will cost approximately $500,000. The entire structure will be occupied by the Roberts, Johnson & Rand Shoe Co. as general offices, sample-rooms, storerooms and shipping depot. The demolition of the old structures on the site has been completed. Excavations for the foundation and basement will be begun at once. The plans for the building were drawn by Theodore C. Luke, Arch., 308 North Sixth St. The outside material will be light limestone relieved by granite trimmings. Skeleton steel frame work will be used. It will be fireproof. The building will be ten stories with sub-basement and will cover an area of 107 ft. on Washington Ave. and Lucas Ave., by a depth of 133 ft. along 15th St. The total floor space will be 15,000 sq. ft.

ST. JOSEPH, MO.—Bids are asked by H. H. Smith, Secy. Bd. School Dirs., until 7.30 p. m., Nov. 30, for the erection of the Robidoux School, at Tenth and Edmond Sts. Separate bids will be received on heating, plumbing and ventilating. Eckel & Boschen, Archs., Sixth and Edmond Sts.

CARTHAGE, MO.—James Knox Taylor, Superv. Arch., Treasury Dept., Washington, D. C., has awarded contract to DIETER & WENZEL CONSTRUCTION CO., Joplin, Mo., for the construction of a post-office at Carthage, Mo., at $78,770. Time, Dec. 1, 1909.

TYLER, TEX.—W. C. WHITNEY, of Beaumont, Tex., has secured contract for erection of a $150,000 court-house.

TEMPLE, TEX.—See item under Manufacturing Plants.

OKLAHOMA CITY, OKLA.—Mauran, Russell & Garden, Archs., Chemical Bldg., St. Louis, will start on plans for a hotel for the Huckins estate, Oklahoma City. The building will cost $500,000.

TULSA, OKLA.—The School Board has let contract to A. J. BUCK at $ for erection of three fireproof reinforced concrete s. room school buildings. W. Rhode is Mayor.

TRINIDAD, COLO.—Bids were received as follows Nov. 20 by James Taylor, Superv. Arch., Treasury Dept., Washington, D. C., for the construction of a post-office building at Trinidad, Colo.: & Wen- 163; W. O. Morrison, Denver, $65,950; Ladd Sanger Construction Co., $64,- Colo., $70,300; George Hinch Denver, cago, $74,900. Time, Jan. 1, Chi-

EUGENE, ORE.—James Taylor, Superv. Arch., Treasury Dept., Washington, D. C., has awarded to WELCH BROS., Salem, Ore., contract for the construction of the post-office at Eugene, Ore. $54,957. Time, Dec. 1, 1909. A list of bids was given on Nov. 12.

BAKER CITY, ORE.—Bids received as follows Nov. 24 by James Taylor, Superv. Arch., Treasury Dept., Washington, D. C., for the construction of a post-office building at Baker City, Campbell Building Co. of Utah, Salt Lake City Utah, $62,964; C. A. Gray, Portland, Ore., $65,998; George C. Monroe, Co. Ore., $68,987; Northern Construction Co., Milwaukee, Wis., $71,000; Welch Bros., Salem, Ore., $66,824; North Western Construction Co., Wahpeton, N. Dak., $65,000. Time, Dec. 31, 1909.

PASADENA, CAL.—A. B. Benton, Arch., 14 North Spring St., Los Angeles, has prepared plans for a building for the Pasadena Y. M. C. A., to cost $100,000.

SACRAMENTO, CAL.—The following bids were received for furnishing the proposed jail with cells: Champion Iron Co., 2-tier, $63,900; 3-tier, $79,900. Stewart Jail Co., 2-tier, $13,890; 3-tier, $41,340. Parrells Safe Co., 2-tier, $64,500; 3-tier, $82,600. Burrell Bridge Co., 2-tier, $69,870; 3-tier, $83,900. Von Dorn Iron Works Co., 2-tier, $63,868; 3-tier, $81,000. J. C. McCarthy, 2-tier, $59,000; 3-tier, $59,000. Pauly Jail and Bridge Co., 2-tier, $62,123; 3-tier, $81,313. The total cost of the building is estimated at $225,000. R. A. Herold, Bryte Bldg., Sacramento, is Arch.

The Masonic lodges of Sacramento have incorporated under the name of the Masonic Temple Association to construct a building. They have purchased ground 160 × 160 ft. on the corner of J and Twelfth Sts. and have received subscriptions of stock warranting them to proceed with the construction of a $500,000 building, it is stated. The proposed building will contain stores on the ground floor fronting on J and Twelfth Sts., with five floors of offices above, and on the Twelfth St. side of the lot a Class A theater will be built. The two upper floors of the building will be occupied by the various lodges, with a Scottish Rite hall. D. H. Burnham & Co., Railway Exchange, Chicago, Ill., are Archs.

SAN FRANCISCO, CAL.—A permit has been granted to Balfour, Guthrie & Co., 320 Sansome St., for an office building to be built on the north side of California St., 45 ft. east of Sansome St., to cost $100,000.

The new quarters to be built at the Presidio will comprise 70 different buildings. Plans and specifications have been forwarded to Washington by Major George McK. Williamson. The quarters will be sufficient to house 14 companies of coast artillery, each company having individual quarters. Besides these there will be individual sets for all the officers. There will be the headquarters, stables, hospital and warehouses also. The quarters will be erected at Fort Winfield Scott. The buildings will be of brick or concrete, with all modern improvements. The cost will be more than $500,000. It is expected that bids for the work will be called for next month and that construction will begin early in the year.

Bids were received on Nov. 9 by the Board of Public Works for putting in the interior partitions, plastering, cement work, carpenter and mill work, as well as painting, on the new infirmary building which is located on the Almshouse tract. The bids and bidders were as follows. The Condon-McGlynn Co., 789 Mission St., $91,200; Knowles & Keyser, $97,983; Lange & Bergstrom, Investors Bldg., $103,063.

We are advised by Righetti & Kuhl, Archs., 1946 Post St., San Francisco, that contract has been awarded to CHARLES HOGGANS, 154 Stanton St., for construction of a 4-story hotel, 27.6 × 120 ft., at Polk and O'Farrell Sts. It will be of Class C construction, steel and terra cotta, and will cost $50,000; equipment, $15,000

LOS ANGELES, CAL.—The contract for the construction of the first two stories of the Consolidated Realty Co.'s 10-story store and office building at the corner of Sixth and Hill Sts. has been awarded to WEYMOUTH CROWELL, Pacific Electric Bldg., on his bid of $111,000. He recently completed the contract for the retaining walls of the same building. The contract includes the reinforced-concrete work, plumbing, gas-fitting, sewerage, steam heat, electric wiring, temporary roof, metal covered frames, skylights, plastering, carpenter work, iron work, hardware, painting, glazing, granite, marble and tile work. Harrison Albright, Laughlin Bldg., is Arch.

GOLDFIELD, NEV.—Press reports state that the Treasury Department, Washington, D. C., will build a post-office on Main, Broadway and Gold Sts., Goldfield, on a site donated by McDaniel, Jensen & Hedley. The building will cost $75,000.

ST. ANTHONY, IDAHO.—Bids are asked until Dec. 19 for construction of a press brick court-house for the city of St. An-

thony and Fremont County. The building will have three stories and basement and will cost $[illegible],000.

MONTREAL, QUE.—E. & W. S. Maxwell, Archs., Beaver Hall Sq., have prepared plans for a proposed observation ward for the Victoria Hospital.

TORONTO, ONT.—The Board of Governors of the University of Toronto have received permission from the Ontario Government to raise funds to erect a building for the Faculty of Pedagogy, at the corner of Spadina Ave. and Bloor St. The building will cost $150,000.

EDMONTON, ALTA.—Bids are asked by John [illegible], Deputy Minister of Public Works, Edmonton, until noon, Dec. 1, for the supply and delivery of all granite, cut the stone to set, which may be required in connection with the Parliament Buildings now being erected in the city of Edmonton.

VICTORIA, B. C.—A fireproof hotel, to cost $[illegible],000, is to be erected by W. A. Bauer, of this city, at the corner of Howe and Pender Sts. It will be ready for occupancy within a year. The hotel will contain [illegible] rooms. Bids will be called as soon as the plans are completed.

WATER SUPPLY—IRRIGATION.

(denotes that this work is advertised in Engineering News.)*

MANCHESTER, MASS.—The Water Board on Nov. 9 awarded the contract to GEORGE S. SINNICKS, at $11,000 for the construction of the pumping station at Gravel Pond. The station will be of brick and concrete, with slate roof, copper gutters, and granolithic floors.

WATERBURY, CONN.—The Board of Aldermen on Nov. 16 authorized R. A. Cairns, City Engr., to prepare plans for the construction of a reservoir above the Wigwam on the branch at Thomaston. Estimated cost, $950,000.

WALLINGFORD, CONN.—The citizens voted on Nov. 11 to issue $35,000 of bonds for the extension of the water mains to Yalesville.

CANASTOTA, N. Y.—Knight & Hopkins, Consult Engrs., 101 West Dominick St., Rome, N. Y., have been directed by the Water Board to prepare plans and specifications and furnish estimate of cost for the construction of an additional storage reservoir for the water system.

*AMSTERDAM, N. Y.—Bids are asked by the Board of Water Commissioners until 8 p. m., Dec. 8, for hauling and delivering c.-i. pipe and for constructing a cast-iron pipe line therewith. Frank H. McConnell is Secy. Bd.

NEW YORK, N. Y.—See item under Light and Power Plants.

*NEW YORK, N. Y.—Bids were received as follows on Nov. 17 by the Board of Water Supply for making borings along one or more lines south of Hill View reservoir, lying mainly in the Boroughs of the Bronx, Manhattan and Brooklyn, including lines crossing the Harlem River, probably between Seventh Avenue and Washington Bridge, and the East River, approximately between the Williamsburg and Brooklyn bridges, the work being divided into sections, the prices being per cu. ft.: Healey Sewer Construction Co., 21 Park Row, New York, Section 1, $2.95; Section 2, $2.98; Section 3, $3; Section 4, $2.95; Section 5, $2.95; Section 6, $2.98; Section 7, $3; Section 8, $15; Section 9, $2; Section 10, $7.79. United Engineering & Contracting Co., 32 East 33d St., New York, $3.36, $3.74, $5.93, $6.21, $7.61, $5.23, $8.80, $50, $5, $15.35. Phoenix Construction Co., 21 Park Row, New York, $2.84, $4.25, $5.35, $7.80, $6.80, $7.30, $9.10, $45, $6, $9. George H. St. Clair, $3, $3, $3.50 $6, $6, $6, $8, $14.50, $1, $4. Charles H. Strong Son Co., $1.75, $1.85, $2.95, $3.50, $4, $4, $6, $30, $4, $11. Sullivan Machinery Co., 42 Broadway, New York, $4.50, $5, $6, $4.50, $4.50, $5, $6, $20, $5, $20. Snare & Triest Co., 143 Liberty St., New York, $1.80, $1.95, $2.10, $4.12, $3.75, $4.20, $4.90, $30, $4.50, $4.20.

NEW YORK, N. Y.—Bids are asked until 2 p. m., Dec. 9, by John H. O'Brien, Comr. Water Supply, Gas and Electricity, for furnishing, delivering and laying water mains in 16th, 17th, 18th, 19th and 20th Sts., and in Irving Pl., Borough of Manhattan.

PASSAIC, N. J.—The Committee on Water Supply has advised the city to enter into a contract with Jersey City to supply water the report being carried. The city will lay its own pipes and a main from Passaic to Allwood, a mile away. Estimated cost, $348,955. Thomas R. Watson is City Clk.

NEWARK, N. J.—The Board of Public Works has adopted a resolution requesting the City Council to issue $100,000 of bonds for the extension of the water mains.

PITTSBURG, PA.—We are officially advised that the NATIONAL WATER MAIN CLEANING CO., 27 William St., New York, was awarded the contract on Nov. 23 by the city for cleaning about 10,360 ft. of water mains at 17 cts. per ft. for 6-in. and 10 cts. for 8-in. pipe.

POTTSVILLE, PA.—COX, REIGEL & CO. have been awarded the contract for the excavation work on the new reservoir being constructed on Black Creek by the Lehigh Valley Coal Co.

BRIDGEVILLE, DEL.—The citizens have voted in favor of installing a system of water-works.

*WILMINGTON, DEL.—We are officially advised that bids were received as follows on Nov. 23 by the Board of Water Commissioners for the construction of a covered, slow sand filtration plant, together with filter water reservoir, filter sand washing apparatus and other appurtenances: Coleman Bros., 15 Court Square, Boston, Mass., $257,-000; Ley Construction Co., Springfield, Mass., $266,315; Norcross & Edmonds, $279,-000; Millard Construction Co., $281,150; MacArthur Bros., 11 Pine St., New York, $289,000; A. S. Reed & Bros. Co., $289,347; William Steel & Sons Co., 1600 Arch St., Philadelphia, Pa., $289,858; John A. Kelley Co., Hadden Heights, N. J., $289,900; Manufacturers' Contracting Co., Dupont Bldg., Wilmington, $296,531; Harrigan & Co., $297,-857; Ferro-Concrete Construction Co., Richmond and Harriett Sts., Cincinnati, Ohio, $317,150; David Peoples, Betz Bldg., Philadelphia, $344,800; Bunting Bull Co., $354,-000. Engineer's estimate, $267,900. John A. Kienle is Ch. Engr. Bd.

RICHMOND, VA.—The Council Committee on Water has awarded contracts as follows for new pumping station and electric machinery. To DIMMICK PIPE CO., Birmingham, Ala., for c.-i. pipe and special castings for a new force line from the new pump house to the reservoir, at $19,303. Charles E. Balling is City Engr.

PARKERSBURG, W. VA.—Bids are asked until Nov. 27 by the city for 7,650 ft. of 6-in. pipe with necessary fittings, hydrants, etc., in the Eighth Ward, and about 2,130 ft. of 8-in. pipe, etc., on Second, Green and Third Sts. Frank Good is City Audr.

STATESVILLE, N. C.—Se item under Manufacturing Plants.

HAMLET, N. C.—We are officially advised that the Hamlet Water Co. does not contemplate making any extensions to water mains as noted last week.

SENECA, S. C.—The citizens on Nov. 9 voted to issue $25,000 of bonds for the construction of water-works and an electric light plant. D. W. F. Austin is Chn. Bd. Pub. Wks.

PENSACOLA, FLA.—Bids were received as follows on Nov. 21 by the Bureau of Yards and Docks, Navy Department, Washington, D. C., for installing water mains, pumping machinery, etc., at the navy yard, Pensacola: Central Metal & Supply Co., 609 East Lombard St., Baltimore, Md., $10,-995; McCay Engineering Co., 9 East Lexington St., Baltimore, Md., $9,777; Newport Plumbing & Heating Co., Newport News, Va., $9,938; Henry Monk, Fort Barancas, Fla., $10,215; D'Olier Engineering Co., 121 South Eleventh St., Philadelphia, Pa., $9,-726 and $9,876; Joseph L. Sweigard & Co., Betz Bldg., Philadelphia, Pa., $9,987.

*GADSEN, ALA.—The contract for the extension of the water-works was awarded on Nov. 14 to the CORINTH ENGINE & BOILER WORKS, of New Orleans, La. The bid of this company was the lowest submitted.

NASHVILLE, TENN.—J. H. Fall & Co., of Nashville, are the lowest bidders at $37,-383, for furnishing iron pipe for the Water Department. The contract calls for 164 tons of 8-in., 314 tons of 12-in. and 1,350 tons of 6-in. pipe. W. W. Southgate is City Engr.

NEWPORT, KY.—The proposed improvements to the water-works system will cost about $85,000. W. L. Glasier is Supt. W.-Wks.

SEBREE, KY.—The city has voted $12,-000 of bonds for the construction of a system of water-works, and desires an engineer to prepare plans and specifications. C. H. Ramsey is Mayor.

SANDUSKY, OHIO.—Bids are asked by the Board of Public Service until noon, Nov. 27, for constructing a partition wall and ceilings over new engine room and filters, at the filtration plant. A. J. Stoll is Pres. Bd.

GRAND RAPIDS, MICH.—Bids will be received until Dec. 3 by the Board of Public Works. Samuel A. Freshney, Secy. and Gen. Mgr. for furnishing 847 water meters for the city.

A 20-in. water-main will be laid in the west side to supply the north end.

*HERRIN, ILL.—Bids will be received by the City Engineer for drilling and casing a deep well for the city, until Dec. 15.

COKATO, MINN.—The contract for drilling a deep well has been let to E. R. BRISTOL, at $5 per ft. complete.

DEER RIVER, MINN.—W. D. LOWELL, of Minneapolis, Minn., has been awarded the contract for laying six blocks of water mains here.

EVELETH, MINN.—Bids will be received until Dec. 15 by the city for 300,000-gallon water tower and tank on Baseball Hill to an elevation of 110 ft., to be connected to the city with suitable mains. Estimated cost, $30,000. Edward P. Burch, of Minneapolis, is Engr.

WICHITA, KAN.—The citizens on Nov. 3 voted in favor of issuing $60,000 of bonds for the construction of municipal water-works. Bert C. Wells is City Engr.

CAMBRIDGE, NEB.—The citizens on Nov. 10 voted in favor of issuing bonds for the construction of water-works.

AUBURN, NEB.—Burns & McDonnell, Scarritt Bldg., Kansas City, Mo., are preparing plans and specifications for the construction of water-works and sewers.

*MURDO, S. DAK.—Bids are asked until Dec. 6 by the city for installing a system of water-works. Dakota Engineering Co., Mitchell, S. Dak., are Engrs.

MURDO, S. DAK.—Bids will be received by the City Clerk until Dec. 7 for pumping station, distribution system and a 50,000-gallon steel tower and tank. The Dakota Engineering Co., Western National Bank Bldg., Mitchell, S. Dak., are Engrs.

THERMOPOLIS, WYO.—We are officially advised that the State Board of Charities and Reform, Cheyenne, Wyo., F. B. Sheldon, Secy., will soon ask for bids for furnishing and laying about 2,600 ft. of 6-in. and 1,300 ft. of 4-in. c.-i. pipe and about 1,000 ft. of 12-in. wood-stave pipe at the Hot Springs State Reserve here.

*KANSAS CITY, MO.—The following are the bids opened on Nov. 9 by the Board of Fire and Water Commissioners for the construction of a settling basin adjoining present settling basins at Quindaro, of either 45 or 50 million gallons capacity: (a) earth embankment, and (b) reinforced concrete wall: W. C. MULLIN, (a) $93,298 (awarded contract); (b) $130,023. Thomas McCarthy, (a) $106,881; (b) $131,252. Flanigan Bros.' Construction Co., (a) $65,083; (b) $98,228. John Mahoney, (a) $101,806; (b) $153,000. Joseph H. Stone, (b) $128,-000. A. J. Middleton Construction Co., (b) $175,000. Midland Bridge Co., (b) $178,000. Urban Construction Co., (b) $120,088. Kansas City Construction Co., (a) $112,750; (b) $135,226. William G. Goodwin is Ch. Engr. Bd.

TEMPLE, TEX.—The Water Commissioners have awarded the contract to H. D. McCOY, Cleburne, Tex., for the erection of a brick pumping station for municipal water-works system.

PARIS, TEX.—The city contemplates the installation of a filter system with a daily capacity of approximately 1,000,000 gallons. Edward H. McCuiston is Mayor.

*HOUSTON, TEX.—The city has awarded the contract to the NORDBERG MFG. CO., House Bldg., Pittsburg, Pa., at $47,515, for the complete installation of a 15,000,000-gallon pump at the municipal water-works. T. C. Tarver is City Engr. List of bidders noted on Oct. 29.

ERICK, OKLA.—The city has voted $20,-000 of bonds for the construction of water-works.

GREELEY, COLO.—The Eagles' Nest reservoir is to be enlarged and will have a capacity of 415,042,230 cu. ft. S. Sanford, of Hardin, Colo., is the claimant for the site and will construct the addition. The reservoir will get its water from the South Platte River. Estimated cost, $137,000.

TACOMA, WASH.—The following bids were opened on Nov. 7 by the Commissioner of Public Works for the enlargement of the reservoir at South 31st St. and Yakima Ave.: Stall & Sweeney, $58,500; Lester Construction Co., $57,400; D. A. Williams, $46,252; Joe Wells, $51,160. The reservoir, which is a part of the low pressure service, is to be increased from a capacity of 6,000,000 gallons to 13,000,000 gallons.

SPOKANE, WASH.—The lowest bid opened on Nov. 4 by the city for 1,000 tons of c.-i. pipe was submitted by McGowen Bros., at $42.20 per ton for 4-in., 10-in. and 12-in. pipe, $42.70 for 6-in. and 8-in. pipe and $41.70 for 14-in. pipe.

MEDFORD, ORE.—The citizens have authorized the purchase of a water right amounting to 7.5 cu. ft. per second from the Fish Lake Water Co. The water will be taken from the north fork of Little Butte Creek, a stream having a low water flow of 100 cu. ft. per second. The city pays $15,000 for the water right. The gravity pipe line will be 16-in. machine-banded, stave-pipe, 23.3 miles in length, having a capacity of 4,000,000 gallons a day. A 2,000,000-gallon distributing reservoir, 100 tons c.-i. pipe, and other appurtenances are included in a contract awarded to I. L. HAMILTON, for $239,100. Associated with Mr. Hamilton in the contract are C. D. Vincent of San Francisco, and Shirley Baker of the Redwood Manufacturing Co., of San Francisco.

*PORTLAND, ORE.—Bids are asked by the U. S. Reclamation Service, 417 Beck Bldg., Portland, until 10 a. m., Jan. 15, for furnishing 25,000 bbls. of Portland cement f. o. b. cars at the works of the bidder.

SAN FRANCISCO, CAL.—The citizens on Nov. 12 voted in favor of authorizing the city to acquire by purchase or condemnation a water supply and works to be owned and operated by the city, the source to be Lake Eleanor, the Hetch-Hetchy Valley and the waters of Tuolumne River. The plan carries with it the authorization to issue bonds to the extent of $600,000, to purchase lands, rights and claims privately held and to begin the construction of work in connection with the development of the plan. Total estimated cost of the project, about $3,000,000. Marsden Manson is City Engr.

LOS ANGELES, CAL.—We are officially advised that the AMERICAN CAST-IRON PIPE CO., per the Crane Co., Los Angeles, has secured the contract for furnishing 2,700 tons bell and spigot c.-i. water pipe at $31.25 per ton, f. o. b. Los Angeles, and 51 tons 16-in. pipe at factory, $17.50 per ton. Bids were opened on Nov. 2.

SAN DIEGO, CAL.—Plans for the construction of La Jolla reservoir are being prepared by A. E. Crowell, City Engr. Estimated cost, $9,000.

CLARKSTON, UTAH.—The WHEELWRIGHT CONSTRUCTION CO., of Ogden, Utah, has been awarded a contract to install a modern system of water-works here. The plans have been prepared and work will begin at once. About ten miles of mains will be laid. The OGDEN PIPE & CLAY CO., Ogden, have the contract for furnishing the material.

TORONTO, ONT.—Allan Hazen, of New York, is preparing plans for the construction of a filtration plant here. C. H. Rust is City Engr.

WINNIPEG, MAN.—Bids are asked by the Chairman of the Board of Control until 11 a. m., Nov. 30, for supplying 5-in. hydrants for high-pressure fire service water-works system. M. Petersen is Secy. Bd.

SEWERAGE.

(denotes that this work is advertised in Engineering News.)*

BROOKLINE, MASS.—JAMES DRISCOLL & SON have been awarded the contract for the sewer and surface water drain in Saw Mill Brook Valley, at $4,166. Other bidders were: Dennis Driscoll, $4,907; T. J. Kelley, $5,097; Fichorn Bros., $7,167; M. J. O'Hearn, $7,305.

BROOKLYN, N. Y.—Bids will be received until Dec. 2 by Bird S. Coler, Boro. Pres., for furnishing material and constructing a sewer in a portion of East 98th St.

NEW BRIGHTON (S. I.), N. Y.—Bids are asked until noon, Dec. 8, by George Cromwell, Pres. Boro. of Richmond, for furnishing materials and labor required for constructing temporary combined sewers and a temporary sanitary sewer and appurtenances in various streets.

UTICA, N. Y.—O'SHEA & LARKIN, Rome, N. Y., have been awarded the contract, at $24,985, for constructing sewer and plumbing at the new county hospital.

HORNELL, N. Y.—Plans will be filed with the State Board of Health, Albany, about Feb. 1 for the construction of a sewage disposal plant for Hornell. Estimated cost, about $100,000.

ALBANY, N. Y.—JOHN M. HOLLER, State and Lark Sts., Albany, was awarded the contract on Nov. 16 by the Board of Contract and Supply for the construction of a sewer under the carriageway of Whitehall St., from Second Ave. north 840 ft. Walter Mellus is City Engr.

ELIZABETH, N. J.—W. J. McCLOUD, 114 Broad St., Elizabeth, was awarded the contract on Nov. 16 by the city for the construction of an intercepting sewer of brick (Parmley block), at $171,297. W. H. Luster, Jr., is City Surv. List of bidders noted last week.

NEWARK, N. J.—Edward S. Rankin, Engr. of Sewers, has estimated the cost of repairing the Peddie St. sewer at $6,900.

McKEESPORT, PA.—The State Health Commissioner has approved the construction of sewers in Rebecca St., Fifth Ave. and Pickwick Alley on condition that all storm water be excluded and that these sewers be part of the general system which is to be considered in relations to the problem of sewage disposal next year. The city is required to furnish plans for the disposal of all drainage from houses and plants by next summer.

ALEXANDRIA, VA.—The city has appropriated $6,000 for sewer and street construction.

ATHENS, GA.—The city has decided to construct 17 sewers, the material to be purchased immediately. Estimated cost, $28,401.

PARK STATION (Knoxville post-office), TENN.—W. C. Crozer, City Engr., will make surveys at once for the construction of a sewer system, for which $15,000 of bonds have been voted.

SPRINGFIELD, OHIO. — GOULD & WRIGHT, of Toledo, Ohio, were awarded the contract on Nov. 13 for constructing sewers in Springfield, at $16,631.

BERNARD HIGGINS was awarded the contract for the construction of two sewers here.

*HARTWELL, OHIO.—We are officially advised that bids were received as follows on Nov. 18 by the Village Council for furnishing the necessary labor and materials for the construction of sewers and for the construction of sewage disposal works here: Emanuel L. Schneider, Ann Arbor, Mich., $48,027; Evan Evans, 1226 Ida St., Cincinnati, Ohio, $48,498; F. M. Bonner & Co., Marion, Ind., $49,784; Hannon & Sieverling, Springfield, Ohio, $51,745; Bosler & Flynn, James Bldg., Chattanooga, Tenn., $53,182; Pease, Buzatt Construction Co., 9 Bradford Bldg., Indianapolis, Ind., $53,218; Walter S. Hollaender, 1339 Race St., Cincinnati, $53,388; C. T. McCracken & Co., 214 Schultz Bldg., Columbus, Ohio, $53,790; Thomas P. Strack, Goodall Bldg., Cincinnati, $57,361; William H. Boyd, 701 Reibold Bldg., Dayton, $57,935; T. J. Backus Construction Co., Reibold Bldg., Dayton, $62,824. The Riggs & Sherman Co., 613 The Nasby, Toledo, Ohio, are Engrs.

STEUBENVILLE, OHIO.—Bids will be received by the Board of Public Service until noon, Dec. 2, for furnishing the necessary labor and materials for the construction of a vitrified pipe sewer in Grandview Ave. and alleys in extension of the Pleasant Heights sewer system. G. Simpson is Clk. Bd.

SOUTH BEND, IND.—L. H. WEBSTER, of South Bend, has secured the contract for constructing pipe sewers here, at $8,667. Bids were opened on Nov. 10.

SHELBYVILLE, IND.—The city has received plans and specifications for the construction of a general sewer system. The estimated cost is as follows: Trunk sewer, $50,670; sanitary sewer, $79,841; three storm sewers, $42,549; machinery to operate the sanitary sewer, $27,994. Bids will be asked soon.

HAMMOND, IND.—The Board of Public Works on Nov. 11 awarded the contract for the Pine St. sewer to O'SHEA & SHEA, of Hammond, at $1.35 a lin. ft., and $5 for house connections.

GRAND RAPIDS, MICH.—J. P. RUSCHE, 4 Portsmouth Terrace, Grand Rapids, was awarded the contract on Nov. 12 by the Board of Public Works for the construction of the a wage pumping station on the west side ditch sewer, at $9,300. L. W. Anderson is City Engr.

BELLEVILLE, ILL.—Plans have been prepared for the Irish Pond sewer system, requiring 5,500 ft. of 12 to 24-in. vitrified clay pipe sewer. Estimated cost, $11,190. Fred. Deutschmann, Jr., is City Engr.

ALTON, ILL.—Plans have been prepared by Thomas Long, City Engr., for constructing sewers in the East Side, and in State and Main Sts. to North Side, distance, 1½ to 2 miles.

LINCOLN, ILL.—The Council has passed an ordinance providing for a vitrified sewer in Hamilton St., from Delavan St. to Denver Ave.

SILVIS, ILL.—Bids were received as follows on Nov. 10 by the Board of Local Improvements for the construction of the sewer here: C. A. BERGLUND, Moline, Ill., $12,550 (awarded contract); Nash Bros., $15,-940; Plambeck & Co., $16,650; Dearborn & Jackson, $12,997; James Follows & Co., $20,-341; Chicago Drainage Co., $15,980; W. A. Edgar, Cedar Rapids, $15,000; People's Construction Co., $12,897.

*GRAND RAPIDS, MICH.—Bids will be received by the Board of Public Works until 8 p. m., Dec. 10, for sewage pumping station machinery consisting in general of four 40-in., four 24-in. and two 18-in. centrifugal pumps, four 175-HP., two 75-HP., two 60-HP. and three 30-HP. electric motors, together with vacuum pumps, piping, etc. L. W. Anderson is City Engr.

DE PERE, WIS.—The Council has awarded the contract for the construction of the west side sewer to THOMAS COULEY, of De Pere, at $1.10 per lin. ft., and $25 each for manholes.

COUNCIL BLUFFS, IOWA.—C. HAFER has been awarded a sub-contract by E. A. Wickham for furnishing 6, 8, 10, 12 and 15-in. sewer pipe for contracts held here by him.

DUBUQUE, IOWA.—Plans are being prepared by Paul Ilg, City Engr., for the construction of 4,000 ft. of 8-in. tile sewer in Middle St. Bids will be asked in the spring.

BURLINGTON, IOWA.—YOUNG & BUESCHER have secured the contract, at $1.33 per lin. ft. for the construction of a sewer in Washington St., and at 90 cts. per cu. yd. for grading, and $1.73 per sq. yd. for paving in alley No. 5.

DES MOINES, IOWA.—The City Engineer has prepared plans for a sewer system to be constructed in Woodlawn Pl. Bids for 13,-000 lin. ft. of 10-in. vitrified pipe laterals, 12, 15, 18 and 24-in. vitrified tile pipe; 1,000 lin. ft. concrete sewer; 24-in. manholes and catch basins, will be asked for about Dec. 1. Estimated cost, $25,000.

WASHINGTON, KAN.—Plans have been prepared by Burns & McDonald, Scarritt Bldg., Kansas City, Mo., for the construction of a sanitary sewer system here. D. O. Reitzel is City Clk.

AUBURN, NEB.—See item under Water-Supply—Irrigation.

LINCOLN, NEB.—William Grant, City Engr., has estimated the cost of reconstructing the storm sewer on N St., from Seventh to Ninth St., at $15,500.

HOBART, OKLA.—Bids will be received by Jesse Field, City Clk., until 8 p. m., Dec. 8, for furnishing material and constructing an extension to the sanitary sewer system. The following are the approximate quantities: 910 ft. of 12-in., 1,900 ft. of 10-in., and 13,080 ft. of 8-in. concrete or vitrified clay pipe; 31 manholes; six flush tanks. O. E. Noble is City Engr.

HOLDENVILLE, OKLA.—The City Engineer is preparing specifications for the construction of a sewerage system.

SEATTLE, WASH.—Bids were received as follows on Nov. 14 by the Board of Public Works for construction of the middle section of the North Trunk sewer; the section extending from the Green Lake section to a point near Ross: Burrell Bridge & Construction Co., Seattle, $700,593; Twohy Bros., Seattle, $746,089; Puget Sound Bridge & Dredging Co., 95 Yesler Way, Seattle, $889,236; Rich-Harris Construction Co., Bailey Bldg., Seattle, $556,496; Krogh & Jessen, Seattle, $836,881. R. H. Thomson is City Engr.

AGNEW, CAL.—See item under Light and Power Plants.

TUCSON, ARIZ.—The Council has passed an ordinance providing for the construction of an 8-in. lateral sewer in Kennedy St., from Main St. to Stone Ave. Frank S. Treat is City Recdr.

TORONTO, ONT.—Bids will be received until noon, Dec. 15 by registered post only by Joseph Oliver, Mayor, Chn. Bd. of Control, for the construction of Section No. 3 of the high level intercepting sewer, the work requiring 1,971 lin. ft. of 7-ft. 6-in., 2,417 lin. ft. of 7-ft. 9-in., 1,557 lin. ft. of 8-ft., and 440 lin. ft. of 8-ft. 6-in. circular sewer, together with manholes, connections, etc.

HAMILTON, ONT.—The contract for laying the mains in connection with the installation of a sewerage system for the residents at the Mountain top has been awarded to G. F. WEBB, at $2.29 per ft., or $26,140. E. G. Barrow is City Engr.

GARBAGE DISPOSAL.

*FORT STRONG (Boston post-office), MASS.—Bids in triplicate, will be received by Capt. R. H. Rolfe, Constructing Q. M., U. S. A., 263 Summer St., Boston, until 10 a. m., Dec. 17, for the construction of a crematory building and the construction and erection of a garbage crematory at Fort Strong, Boston Harbor, Mass.

READING, PA.—The Council has awarded to HARRY J. ADAMS the contract for collection, removal and disposal of garbage, offal and animals for five years at $1.94 per ton.

BEAVER FALLS, PA.—LEWIS & KITCHEN, New York, and 433 Wabash Ave., Chicago, Ill., were awarded the contract on Nov. 17 by the Council for the erection of the garbage furnace here. Bidders noted last week.

COVINGTON, KY.—Ellsworth Woods, Supt. Pub. Wks., has recommended the construction of an additional garbage crematory. Estimated cost, $15,000.

MILWAUKEE, WIS.—Bids will probably be asked in January for the construction of the proposed garbage crematory. Charles J. Poetsch is City Engr.

STREETS AND ROADS.

BROOKLYN, N. Y.—Bids are asked until 11 a. m., Dec. 9, by Bird S. Coler, Pres. Boro. of Brooklyn, for regulating, grading and curbing, repairing with asphalt on a concrete foundation, paving with asphalt block on a concrete foundation and laying sidewalks on various streets.

Bids were opened Nov. 11 by Bird S. Coler, Pres. Brooklyn Borough, for regulating, paving and repaving with granite on concrete foundation Grand St., from Hooper St. to Bridge Plaza. The contract has been awarded to O'GRADY BROS., 71 North Eighth St., Brooklyn, at the following prices: 12,050 sq. yds. granite pavement, with tar and gravel joints, laid outside railroad area, 1-year maintenance, $2.35; 85 sq. yds. granite pavement with tar and gravel joints, laid within railroad area, no maintenance, $2.35; 20 sq. yds. old stone pavement, relaid in approaches, etc., 40 cts.; 2,050 cu. yds. concrete, for pavement foundation, laid outside railroad area, $4.25; 15 cu. yds. concrete, for pavement foundation, laid within railroad area, $4.25; 100 lin. ft. new curb, set in concrete, 70 cts.; 700 lin. ft. old curb, redressed, rejointed and reset in concrete, including 675 lin. ft. heading stones, 25 cts.; 2,460 sq. ft. new granite bridgestones, laid outside railroad area, 65 cts.; 20 sq. ft. old bridgestones, rejointed and relaid, 20 cts.; one sewer basin, complete, $135. Total, $39,284. Other bidders were: Charles Cranford, Foster Ave. and East 16th St., $46,745; Bart Dunn, 444 East 68th St., New York, $45,415; William E. Paulson, 13 Fulton St., $46,799; Charles A. Meyers, 331 Winthrop St., $41,087; Leo E. Kelly, 651 Belmont Ave., $51,219; Joseph Taromino, 42 Pacific St., $41,919; Henry P. George, 40 Washington Ave., Richmond Hill, L. I., $49,-907; Mathew T. Meagher, 15 Orient Ave., $49,778; Scoria Paving Co., 103 Park Ave., New York, $42,905; John E. Quinn, 13-21 Park Row, New York, $41,242; Atlanta Contracting Co., 434 East 91st St., New York, $42,130.

The UVALDE ASPHALT PAVING CO., 1 Broadway, New York, has been awarded the contract by Bird S. Coler, Boro. Pres., for paving with asphalt on a concrete foundation, Blake Ave., from Hopkinson Ave. to Julius St., bids opened Oct. 21, at the following prices: 9,010 sq. yds. asphalt pavement, including binder course, outside of railroad franchise area, 5-year maintenance, $1.30; 23 sq. yds. asphalt pavement, including binder course, within railroad franchise area, no maintenance, $1.30; 1,254 cu. yds. concrete, outside of railroad franchise area, $6; 2 cu. yds. concrete, within railroad franchise area, $6. Total, $19,285.

SYRACUSE, N. Y.—Bids are asked until 1.30 p. m., Nov. 30, by the Board of Contract and Supply for constructing 4 and 5-ft. cement sidewalks on various streets. F. T. Pierson is Secy. Bd.

NEW YORK, N. Y.—Bids are asked by the Park Board until 3 p. m., Dec. 3, for furnishing all the labor and materials for reconstructing the roadway of the Eastern Boulevard in Pelham Bay Park, including surfacing with asphalt mixture, from a point 400 ft. north of the Split Rock Road to the northerly approach of the new bridge over Eastchester Bay, and from the southerly approach of the bridge to the southern boundary of Pelham Bay Park, in the Borough of The Bronx, City of New York.

NEW ROCHELLE, N. Y.—Bids are asked by the Board of Public Works until 8 p. m., Dec. 3, for the furnishing and laying of flagging on the south side of Sickles Ave. and doing the necessary grading. Drawings and specifications are on file in the office of the Board. Charles W. Bryan is Chn. Bd.

*MAMARONECK, N. Y.—See item under Bridges.

AVALON (Allegheny post-office), PA.—Bids will be received by the Borough Engineer until 5 p. m., Nov. 30, for curbing the west side of West Division St., from California Ave. to Forest Ave., approximately 530 lin. ft. of curbing.

WELLSBURG, W. VA.—E. A. FRESHWATER, Chester, W. Va., and LIGGETT, CARMEN & CO., Wellsburg, have been awarded contracts for paving here. E. A. Sheets is Chn. St. Com.

NEWBERRY, S. C.—The city has awarded the contract to the SOUTHERN PAVING CONSTRUCTION CO., Chattanooga, Tenn., at $2.50 per sq. yd. for pa[illegible] Main Sts., 1,200 sq. yd[illegible] brick on a concrete base. Calwell and [illegible] vitrified

TUSCALOOSA, ALA.—Bi[illegible] the Mayor and Board of Al[illegible] p. m., Nov. 27, for the co[illegible] proximately 6,917 sq. yds. [illegible] walk. W. H. Nicol is City [illegible] e asked by [illegible] n until 7.30 [illegible] tion of ap-[illegible] ncrete side-

COLUMBUS, OHIO.—Bids [illegible] until Nov. 30 by the Board [illegible] vice, E. W. Hirsch, Secy. [illegible] material and paving a per[illegible] with asphalt, hard burned [illegible] or other substantial mater[illegible] curb, and necessary sub-d[illegible] basins. be received Public Ser-[illegible] furnishing [illegible] of 224 St. [illegible] or block, [illegible] etting 5-in. [illegible] and catch

CINCINNATI, OHIO.—Bid[illegible] ceived until Dec. 11 by the [illegible] sioners for improving Ritte[illegible] Miami Township. ll be re-[illegible] y Commis-[illegible] Road in

WILLIAMSPORT, IND.—Bi[illegible] the Commissioners of Foun[illegible] til 1 p. m., Dec. 7, for th[illegible] a gravel road in Steuben Tow[illegible] road in Liberty Township, a[illegible] in Liberty and Steuben Town[illegible] road, 15,742 ft. R. L. W[illegible] Audr. asked by [illegible] ounty un-[illegible] ruction of [illegible] a gravel [illegible] ravel road [illegible] length of [illegible] County

CROWN POINT, IND.—Bid[illegible] the Commissioners of Lake [illegible] p. m., Dec. 8, for the constru[illegible] ft. of macadamized road in [illegible] ship, and for the construction [illegible] road in North Township. Wa[illegible] is County Audr. asked by [illegible] until 1 [illegible] of 30,455 [illegible] on Town-[illegible] a gravel [illegible] G. Owens

LAPORTE IND.—Bids are [illegible] Commissioners of Laporte Cou[illegible] 8, for the construction of 6,22[illegible] adamized road in Center Townsh[illegible] H. Miller is County Audr. d by the [illegible] until Dec. [illegible] of mac-[illegible] Charles

(Continued on page 19[illegible])

CONTRACT PRICES.

*BARGE CANAL.—Albany, N. Y.—Bids were received by F. C. Stevens, Supt. Public Works, on Nov. 17, for Barge Canal Contract No. 40. Bids in detail were as follows: (A) Engineer's estimate; (B) Buffalo Dredging Co., Buffalo, N. Y.; (C) Mason & Hanger Co., and Millard & Lupton Co., 50 Church St., New York; (D) MacArthur Bros. Co., 11 Pine St., New York; (E) United Engineering & Contracting Co., 32 East 33d St., New York; (F) American Pipe Mfg. Co.:

Contract No. 40—	(A)	(B)	(C)	(D)	(E)	(F)
Cofferdams, pumping, bailing and draining (lump sum)	$10,000.00	$10,000.00	$10,000.00	$10,000.00	$10,000.00	$10,000.00
Clearing, (lump sum)	2,000.00	2,000.00	2,000.00	2,000.00	2,000.00	1,000.00
100 cu. yds. grubbing	.30	.30	.30	.25	.50	.24
2,336,300 cu. yds. excavation	.93	.83	.83	.77	.78	.86
20 M. ft. sheeting and bracing	50.00	50.00	50.00	57.50	50.00	40.00
430,550 sq. ft. channeling	.20	.23	.20	.24	.20	.16
26,800 cu. yds. forming embankment	.15	.15	.15	.18	.15	.12
6,950 cu. yds. lining	1.50	1.55	1.50	1.70	1.50	1.20
12 M. ft. sawed lumber, (yellow pine or Douglas fir)	55.00	55.00	55.00	65.00	55.00	44.00
770 lin. ft. foundation piles	.30	.30	.30	.35	.30	.24
7,100 cu. yds. second class concrete	7.00	7.00	7.00	8.00	7.00	5.60
37 cu. yds. third class concrete	6.50	6.50	6.50	7.00	6.50	5.20
550 cu. yds. reinforced concrete	10.00	10.00	10.00	11.50	10.00	8.00
11 cu. yds. first class masonry bridge coping	30.00	30.00	20.00	35.00	30.00	24.00
38,520 cu. yds. wash wall	2.50	2.75	2.50	2.90	2.50	1.00
30 sq. yds. second class stone paving	1.50	1.50	1.50	1.70	1.50	1.20
1,100 sq. yds. third class stone paving	1.25	1.25	1.25	1.40	1.25	1.00
150 cu. yds. second class riprap	3.00	3.00	3.00	3.50	3.00	2.40
300 cu. yds. third class riprap	2.50	2.50	2.50	2.90	2.50	2.00
100 cu. yds. fourth class riprap	2.00	2.00	2.00	2.30	2.00	1.60
627,140 lbs. structural steel	.05	.05	.05	.06	.05	.04
5,286 lbs. iron castings	.03½	.035	.035	.04	.035	.028
64,200 lbs. metal reinforcement	.04	.04	.04	.045	.04	.032
525,000 lbs. metal in guard gate	.06	.06	.06	.07	.06	.048
830 sq. yds. wooden pavement, 2¾ ins. thick	2.75	2.75	2.75	3.00	2.75	2.20
550 sq. yds. wooden pavement, 3¾ ins. thick	3.00	3.00	3.00	3.50	3.00	2.40
800 lin. ft. wooden fence	.20	.20	.20	.20	.20	.16
700 lin. ft. lattice railing	2.00	2.00	2.00	2.30	2.00	1.60
550 lin. ft. drilling bolt holes in rock	1.00	1.00	1.00	1.00	1.00	.80
66 lin. ft. trench and back fill for 48-in. pipe	2.00	2.00	2.00	2.00	2.00	1.60
66 lin. ft. relaying 48-in. pipe	.50	.50	.50	.50	.50	.40
For maintaining navigation, lump sum	5,000.00	5,000.00	5,000.00	5,000.00	5,000.00	1,000.00
For maintaining highway traffic, lump sum	500.00	500.00	500.00	500.00	500.00	400.00
Deduct price to be paid to the State of New York for buildings in place which are to be removed by the contractor without expense to the state, lump sum	2,400.00	2,400.00	2,400.00	2,400.00	2,400.00	2,400.00
Deduct price to be paid to the State of New York for existing bridge superstructure in place, which are to be removed the contractor, without expense to the state, lump sum	300.00	300.00	300.00	300.00	300.00	300.00
Totals	$2,516,743	$2,306,702	$2,283,113	$2,199,026	$2,166,298	$2,247,338

*BARGE CANAL.—Albany, N. Y.—Bids were received by F. C. Stevens, Supt. Public Works, on Nov. 17, for Barge Canal Contract No. 46, which is for the construction of the canal from Fox Ride to the southeast corner of the town of Galen, a distance of 9.44 miles. Bids in detail were as follows: (A) Engineer's estimate; (B) P. Sanford Ross, Inc., 277 Washington St., Jersey City, N. J.; (C) Kinser Construction Co., Railway Exchange, Chicago, Ill., and Fort Edward, N. Y.; (D) Crowell & Sherman Co., 3111 Carnegie, Ave., Cleveland, Ohio.; (E) Shanley-Morrissey, Inc., 527 Fifth Ave., New York; (F) North American Dredging Co., 839 Park Row Bldg., New York; (G) American Pipe Mfg. Co., 112 North Broad St., Philadelphia, Pa.; (H) Booth & Flynn, Ltd., Pittsburg, Pa.:

	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)
Clearing (lump sum)	$5,000.00	$5,000.00	$5,000.00	$5,900.00	$6,000.00	$6,000.00	$4,900.00	$5,000.00
5,035,000 cu. yds. excavation	.20	.217	.17	.18	.18	.179	.20	.178
25 M. ft. sheeting and bracing	50.00	50.00	50.00	50.00	60.00	50.00	40.00	50.00
72,000 cu. yds. embankment	.15	.18	.10	.15	.18	.18	.12	.15
1,800 cu. yds. lining	1.50	1.50	1.50	1.50	1.80	1.50	1.20	1.50
M. ft. sawed lumber	55.00	65.00	55.00	55.00	60.00	55.00	44.00	55.00
S M. ft. white oak lumber in lock gates	100.00	100.00	100.00	100.00	120.00	100.00	80.00	100.00
154,000 lin. ft. foundation piles	.25	.25	.25	.25	.30	.25	.20	.25
20 ea. mooring piles	7.00	7.00	7.00	7.00	8.40	7.00	5.60	7.00
362 M. ft. wood sheet piling	50.00	50.00	50.00	50.00	60.00	50.00	40.00	50.00
31,000 cu. yds. second class concrete	6.25	6.45	6.25	5.75	7.25	6.25	7.00	6.75
100 cu. yds. reinforced concrete	10.00	10.00	10.00	10.00	12.00	10.00	8.00	10.00
5 cu. yds. first class masonry bridge coping	30.00	30.00	30.00	30.00	36.00	30.00	24.00	30.00
3,800 cu. yds. second class riprap	2.50	2.50	2.50	2.50	3.00	2.50	2.00	2.50
250 lin. ft. 2½-in. w.-i. pipe and specials	.20	.20	.20	.20	.24	.20	.16	.20
575,400 lbs. structural steel	.05	.05	.05	.05	.06	.05	.04	.05
26,800 lbs. metal reinforcement	.04	.04	.04	.04	.05	.04	.032	.04
12,800 lbs. steel castings	.05	.05	.05	.05	.06	.05	.04	.05
6,600 lbs. iron castings	.06	.06	.06	.06	.07	.06	.048	.06
920 sq. yds. wood pavement	2.75	3.00	2.75	2.75	3.30	2.75	2.40	2.75
3,650 lin. ft. wooden fence	.20	.20	.20	.20	.24	.20	.16	.20
6,000 lbs. w.-i. chain	.06	.06	.06	.06	.07	.06	.048	.06
18 M. ft. B. M. sawed lumber in needles, per M. ft.	100.00	100.00	100.00	100.00	120.00	100.00	80.00	100.00
96,000 lbs. metal in buffer beams	.06	.06	.06	.06	.07	.06	.048	.06
25,000 lbs. metal in lock valves	.12	.12	.12	.12	.14	.12	.096	.12
188,000 lbs. metal in lock gates	.06	.06	.06	.06	.07	.06	.048	.06
4 pairs uprights, including bracing	300.00	300.00	300.00	300.00	350.00	300.00	240.00	300.00
4 No. Gates "A"	250.00	250.00	25.00	250.00	300.00	250.00	200.00	250.00
4 No. Gates "B"	375.00	375.00	350.00	375.00	450.00	375.00	300.00	375.00
24 No. c.-i. idlers	1.50	1.50	1.50	1.50	1.80	1.50	1.20	1.50
8 No. Bearing Shoes	8.00	8.00	8.00	8.00	9.60	8.00	6.40	8.00
25,000 lbs. machinery	.15	.15	.15	.15	.18	.15	.12	.15
Cofferdams, pumping, bailing and draining, lump sum	12,000.00	14,000.00	12,000.00	12,000.00	14,400.00	14,400.00	14,400.00	14,000.00
For removal of bridge superstructure, lump sum	200.00	240.00	200.00	200.00	240.00	200.00	160.00	200.00
For maintaining highway traffic, lump sum	1,500.00	1,800.00	1,500.00	1,500.00	1,800.00	1,500.00	1,200.00	500.00
Deduct price to be paid to the State of New York for buildings in place which are to be removed by the contractor without expense to the state	250.00	250.00	250.00	250.00	200.00	250.00	250.00	250.00
Total	$1,367,583	$1,464,218	$1,212,833	$1,251,072	$1,330,710	$1,267,408	$1,362,400	$1,274,830

*BARGE [illegible]AL.—Albany, N. Y.—Bids were received by F. C. Stevens, Supt. of Public Works, Nov. 18 for Barge Canal Contract No. [illegible]. Itemized bids were as follows—(A) Engineer's estimate; (B) F. J. McCain Construction Co., Mercer, Pa.; (C) Booth & Flynn, Ltd., Pittsburg, Pa.; (D) Mason & Hanger Co., and Milland & Lupton Co.; (E) American Pipe Mfg. Co.; (f) Shanley-Morrissey, Inc.; (G) Scott Bros., Baldwinsville, N. Y.; (H) MacArthur Bros. Co.; (I) Coast & Interior Contracting Co., Fayetteville, N. Y.; (J) Acme Engineering & Contracting Co., Schenectady, N. Y.:

	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)
Clearing, [illegible]um	$100.00	$100.00	$100.00	$100.00	$100.00	$80.00	$100.00	$100.00	$100.00	$100.00
4,800 cu. [illegible] grubbing	.35	.35	.35	.35	.35	.28	.35	.35	.40	.35
550,000 cu. [illegible] excavation	.90	1.00	.75	.84	.73	1.00	.75	.82	.82	.74
50 M. [illegible] M. sheeting and brac-	50.00	50.00	50.00	50.00	50.00	40.00	50.00	50.00	60.00	60.00
[illegible] M. ft.	.25	.25	.25	.25	.25	.20	.25	.25	.30	.29
1,000 lin. [illegible]und timber bracing..	.18	.215	.16	.18	.21	.144	.14	.18	.21	.18
170,000 sq. [illegible]anneling	.05	.05	.05	.05	.05	.04	.05	.05	.06	.05
30,000 cu. [illegible]embankment, wet....	.12	.12	.12	.12	.12	.096	.12	.14	.14	.12
43,000 cu. [illegible]embankment, dry...	1.50	1.50	1.50	1.50	1.50	1.20	1.50	1.50	1.80	1.50
510 cu. [illegible] lining										
5.6 M. [illegible] M. sawed lumber										
[illegible] pine or Douglas fir),										
[illegible] ft.	55.00	55.00	55.00	55.00	55.00	44.00	55.00	55.00	65.00	66.00
14 M. [illegible] M. sawed lumber in										
[illegible] per M. ft.	100.00	100.00	100.00	100.00	100.00	80.00	100.00	100.00	100.00	100.00
25 M. [illegible] M. white oak lumber										
[illegible]er sills and gates, per										
M.	100.00	100.00	100.00	100.00	100.00	80.00	100.00	100.00	100.00	100.00
3,000 lin. [illegible] foundation piles.....	.35	.35	.35	.35	.35	.28	.35	.35	.40	.40
68,000 cu. [illegible] second-class concrete.	7.25	8.00	6.50	6.95	7.10	7.50	6.25	6.80	7.00	6.75
1,500 cu. [illegible] reinforced concrete...	9.00	10.80	9.00	10.00	10.00	8.00	9.00	9.00	9.00	10.50
5 cu. [illegible] first-class masonry										
[illegible]	30.00	30.00	30.00	30.00	30.00	24.00	30.00	35.00	30.00	26.00
2,000 cu. [illegible] wash wall.....	2.50	2.50	2.50	2.50	2.50	2.00	2.50	2.50	2.80	2.50
72 sq. [illegible] third-class stone pav-										
[illegible]	1.25	1.25	1.25	1.25	1.25	1.00	1.25	1.25	1.45	1.50
300 cu. [illegible] fourth-class riprap..	2.50	2.50	2.50	2.50	2.50	2.00	2.50	2.50	2.75	3.00
180,000 lbs. [illegible]uctural steel	.05	.05	.05	.05	.05	.04	.05	.05	.06	.045
62,000 lbs. [illegible]etal reinforcement.....	.04	.04	.035	.04	.04	.032	.04	.04	.04	.04
28,000 lbs. [illegible]on castings, plain.....	.035	.035	.035	.035	.035	.028	.035	.035	.04	.035
26,000 lbs. [illegible]ron castings, machined..	.06	.06	.06	.06	.06	.048	.06	.06	.07	.06
770,000 lbs. [illegible]metal in lock gates.....	.06	.06	.05	.06	.06	.048	.06	.06	.06	.055
240,000 lbs. [illegible]metal in buffer beams....	.06	.06	.06	.06	.06	.048	.06	.06	.07	.055
100,000 lbs. [illegible]metal in lock valves.....	.12	.12	.12	.12	.12	.096	.12	.12	.11	.10
360 sq. [illegible]ds. wooden pavement, 4"										
thick	3.60	3.60	3.60	3.60	3.60	2.40	3.60	2.20	2.90	3.60
1,150 lin. ft. wooden fence.....	.20	.20	.20	.20	.20	.16	.20	.20	.22	.24
1,300 lin. ft. drilling bolt holes in										
[illegible]ces	.60	.72	.60	.60	.60	.48	.60	.60	.60	.60
For raising bridge superstruc-										
[illegible]ures, lump sum	2,000.00	2,000.00	2,000.00	2,000.00	2,000.00	1,600.00	2,000.00	2,000.00	2,000.00	2,000.00
For maintaining highway traf-										
[illegible]fic, lump sum.....	2,000.00	2,000.00	2,000.00	2,000.00	2,000.00	1,600.00	2,000.00	2,000.00	1,000.0	2,000.00
3 store houses, each.....	800.00	800.00	800.00	800.00	800.00	640.00	800.00	850.00	750.00	800.00
2 office buildings, each.....	250.00	250.00	250.00	250.00	250.00	200.00	250.00	300.00	300.00	250.00
Cofferdams, pumping, bailing										
and draining, lump sum.....	25,000.00	25,000.00	30,000.00	25,000.00	25,000.00	30,000.00	25,000.00	30,000.00	28,000.00	25,000.00
Total	$1,175,623	$1,290,429	$1,036,023	$1,123,723	$1,078,523	$1,221,208	$1,018,323	$1,114,030	$1,127,982	$1,048,879

*BARGE CANAL.—Albany, N. Y.—The itemized prices of the bids received by F. C. Stevens, Supt. Public Works, on Nov. 18, for Barge Canal Contract No. 47, which is for the construction of the canal from the southeast corner of the town of Galen to a point near the New York Central R. R. crossing at Lyons, a distance of 14.46 miles, were as follows—(A) Engineer's estimate; (B) Booth & Flynn, Ltd., Pittsburg, Pa.; (C) Butler Bros.-Hoff Co., 1170 Broadway, New York; (D) Crowell & Sherman Co., 3111 Carnegie Ave., Cleveland, Ohio; (E) American Pipe Mfg. Co., Philadelphia, Pa.:

	(A)	(B)	(C)	(D)	(E)
50 acres clearing, per acre.....	$25.00	$25.00	$25.00	$25.00	$25.00
800 cu. yds. grubbing.....	.30	.30	.30	.30	.30
5,310,000 cu. yds. excavation.....	.23	.217	.225	.199	.257
25 M. ft. B. M. sheeting and bracing, per M. ft.....	50.00	50.00	50.00	50.00	50.00
32,500 cu. yds. forming embankment	.15	.15	.15	.15	.15
1,120 cu. yds. lining	1.50	1.50	1.50	1.50	1.50
4 M. ft. B. M. sawed lumber (yellow pine or Douglas fir), per M. ft.....	55.00	55.00	55.00	55.00	55.00
32 M. ft. B. M. sawed lumber (hemlock), per M. ft.....	50.00	50.00	50.00	50.00	50.00
7 M. ft. B. M. white oak lumber in miter sills, per M. ft.	100.00	100.00	100.00	100.00	100.00
1 M. ft. B. M. sawed lumber (white oak), per M. ft.....	80.00	80.00	80.00	80.00	80.00
320 lin. ft. round timber in cribs.	.15	.15	.15	.15	.15
410 cu. yds. stone filling in cribs.	1.50	1.50	1.50	1.50	1.50
2,100 lin. ft. foundation piles, 15' to 24' long	.25	.25	.25	.25	.25
8 mooring piles, 20' long, each.	7.00	7.00	7.00	7.00	7.00
7 M. ft. B. M. wooden sheet piling, per M. ft.....	50.00	50.00	50.00	50.00	50.00
23,000 cu. yds. second-class concrete	6.40	6.50	6.00	6.10	6.40
13 cu. yds. reinforced concrete..	10.00	10.00	10.00	10.00	10.00
2 cu. yds. first-class masonry bridge coping	30.00	30.00	30.00	30.00	30.00
50 sq. yds. second-class stone paving	1.50	1.50	1.50	1.50	1.50
850 cu. yds. second-class riprap..	2.50	2.50	2.50	2.50	2.50
865 lin. ft. 15" vit. pipe, laid....	.60	.60	.60	.60	.60
865 lin. ft. trenching and backfilling for 15" pipe.....	.30	.30	.30	.30	.30
158,000 lbs. structural steel.....	.05	.05	.04	.05	.05
25,000 lbs. metal reinforcement....	.04	.04	.04	.04	.04
1,750 lbs. wrought iron.....	.04	.04	.04	.04	.04
10,400 lbs. steel castings.....	.05	.05	.05	.05	.05
2,000 lbs. iron castings, plain.....	.03½	.035	.035	.035	.035
6,600 lbs. iron castings, machined.	.06	.06	.06	.06	.06
330 sq. yds. wood pavement.....	2.75	2.75	2.75	2.75	2.75
925 lin. ft. wooden fence.....	.20	.20	.20	.20	.20
470 lin. ft. w.-i. pipe railing....	1.00	1.00	1.00	1.00	1.00
14 M. ft. B. M. sawed lumber in needles, per M. ft.....	100.00	100.00	100.00	100.00	100.00
24,000 lbs. metal in lock valves.....	.10	.10	.10	.10	.10
90,000 lbs. metal in buffer beams...	.06	.06	.05	.06	.06
180,000 lbs. metal in lock gates.....	.06	.06	.05	.06	.06
For maintaining highway traffic, lump sum	500.00	500.00	500.00	500.00	500.00
Cofferdams, pumping, bailing and draining, lump sum.....	16,000.00	16,000.00	16,000.00	16,000.00	16,000.00
Total	$1,434,148	$1,307,418	$1,394,118	$1,262,638	$1,579,518

STREETS AND ROADS.

(Continued from page 190.)

WASHINGTON, IND.—Bids are asked by Thomas Nugent, County Audr., until 2 p. m., Dec. 8, for the construction of three gravel roads in Washington Township.

FRANKFORT, IND.—Bids are asked by the Commissioners of Clinton County until 2 p. m., Dec. 10, for the construction of the following gravel roads: Road No. 64, 7,914 ft.; No. 70, 15,834 ft.; No. 72, 15,744 ft.; No. 113, 10,616 ft.; No. 110, 5,285 ft.; No. 115, 12,166 ft. in length. Charles F. Cromwell, County Audr.

HUNTINGTON, IND.—Bids are asked by the Commissioners of Huntington County until Dec. 7, for the construction of 6,544 ft. of crushed stone road in Huntington Township. John W. Weaver is County Audr.

Bids are asked by the Commissioners of Huntington County until 10 a. m., Dec. 9, for the construction of two gravel roads in Huntington County.

BLOOMFIELD, IND.—Bids will be received by the Commissioners of Greene County until 2 p. m., Dec. 8, for the construction of a gravel and macadamized road in Stockton Township. P. M. Cook is County Audr.

ANDERSON, IND.—Bids will be received by the Commisioners of Madison County, until Dec. 28, for the construction of four gravel roads in Van Buren Township, 10,610, 10,763, 7,858, 10,660 and 10,686 ft. in length respectively, and for the construction of a gravel road on the county line, the road being 10,056 ft. in length. W. S. Richards is County Audr.

MUSKEGON, MICH.—Bids will be received until noon, Dec. 7, by the City Recorder for furnishing the material and grading and paving several streets and alleys. B. H. Tellman is City Recdr.

KANSAS CITY, KAN.—Bids will be received until Dec. 7 by the County Commissioners, Kansas City, for furnishing the material and macadamizing De Fries and Gibbs Roads, and resurfacing South West Boulevard and Shawnee Road. Frank M. Holcomb is County Clk.

FORT RILEY, KAN.—Bids will be received until 10 a. m., Dec. 14, by Capt. W. M. Whitman, Constructing Q. M., U. S. A., Fort Riley, for constructing macadam roads, curbing and guttering, catch basins and grading.

MUSKOGEE, OKLA.—Bids will be received until Nov. 30 by the city for asphalt paving, about 14,000 sq. yds. L. B. Kinsey is City Engr.

GUTHRIE, OKLA.—Bids will be received about Nov. 29 for 120 blocks of paving, 67 blocks of which will be rock asphalt and 62 blocks brick. W. W. Miller is City Engr.

DENVER, COLO.—Bids are asked until noon, Dec. 7, by Frederick R. Ross, Chn. Bldg. Com., for grading library lot and sidewalk area and for putting in curbs, walks, etc.

OLYMPIA, WASH.—Bids are asked until 2 p. m., Dec. 4, by the State Highway Board for clearing, grubbing, grading and draining State Aid Road No. 27. Joseph M. Snow is Secy. Bd.

SALT LAKE CITY, UTAH.—Bids are asked by the Board of Public Works until 8 p. m., Nov. 27, for constructing cement sidewalk in extension No. 141. Louis C. Kelsey is City Engr.

LEWISTON, IDAHO.—Bids are asked by the city until 8 p. m., Nov. 30, for about 54,000 sq. yds. of bitulithic pavement, combined curbs and gutters. J. E. Nickerson is City Clk.

MANUFACTURING PLANTS.

(denotes that this work is advertised in Engineering News.)*

TORRINGTON, CONN.—The TORRINGTON BUILDING CO. has been awarded the contract for the construction of a 2-story brick factory building 404 × 134 ft., for the S. Slater & Sons Co., of Webster, Mass. The building will cost $180,000.

NEW YORK, N. Y.—We are advised by Kirby, Pettit & Green, Archs., 103 Park Ave., that the American Bank Note Co., Warren L. Green, Pres., has bought from the George F. Johnson's Sons Co. a tract of 123 lots, in the Hunt's Point Section of the Bronx. On this site it will erect a building which will group under one roof its printing plants, now in Trinity Pl., on Sixth Ave. and elsewwhere in the city. The plant will afford employment for about 2,000 hands, and eventually there will be work under its roof for at least 5,000 persons. About $2,000,000 will represent the cost of ground, building and its equipment. The property to be improved by the American Bank Note Co. comprises all of that on the northerly side of Lafayette Ave., from Manida St. to the tracks of the New York, New Haven & Hartford R. R., and all of that on both sides of Garrison Ave., from Manida St. to Lafayette Ave., besides many contiguous parcels, excepting 18 lots in Manida St. The combined frontages of the tract of land acquired by the bank note company is 1,475 ft. To furnish adequate freight facilities for this big plant, the railroad company will extend sidings from its Hunt's Point station to the property and erect a suitable freight house. The plans for the plant will be finished in about two months.

YONKERS, N. Y.—The Otis Elevator Co., 17 Exchange Pl., New York, has awarded contract to GEORGE T. KELLEY, Yonkers, for a brick and steel foundry building to be erected at Locust and Atherton Sts., Yonkers, N. Y. The plant will have double the capacity of the present foundry building, and when completed will give employment to about 100 additional workmen. Work on the building will be started at once and completed about March 1.

NEWARK, N. J.—We are advised by J. Strombach, 238 Washington St., Newark, that a 1-story brick factory will be built by Charles Becker & Co., 829 Broad St., and will be located in Tenth St., near 15th Ave. The structure will be in two sections, one being 38 × 100 ft., the other 22 × 80 ft. The following contracts have been let: Masonry, THEODORE HERRMANN, $4,200; carpentry, CHARLES SCHAEDEL & BRO.; plumbing, CHARLES STREBINGER & SONS. Cost, $8,000.

PITTSBURG, PA.—The Williams Patent Crusher & Pulverizer Co. will erect a plant consisting of 1 and 3-story buildings at 811 Montgomery St., to cost $25,000.

PHILADELPHIA, PA.—We are officially advised that Ballinger & Perrott, Archs., 1200 Chestnut St., Philadelphia, have awarded a contract to ROYDHOUSE-AREY & CO., Delaware and Van Kirk Sts., for a manufactory building to be erected at 23d and Arch Sts., for George P. Pilling & Son Co., 23d and Arch Sts. The building will be 62 × 65 ft., five stories in height. It will have brick walls, and slow burning wood construction for floors and roof, except the first story, which will have a reinforced concrete fireproof ceiling. Window sills and lintels will be of reinforced concrete and the wall coping of salt-glazed terra cotta.

WARREN T. MILLER has a contract to build a 2-story factory, 35 × 110 ft., with a wing, 46 × 100 ft., at the corner of 24th and Wood Sts., for the Ford & Kendig Co., 1428 Callowhill St. The contract price is $24,000.

HAGERSTOWN, MD.—A silk mill is to be established here and contract has been awarded to CHARLES W. LLOYD for its construction. The structure will be two stories, 30 × 100 ft., and will be equipped with silk making machinery.

BALTIMORE, MD.—A 3-story brick factory and warehouse will be erected at the corner of Holliday and Hillen Sts., by Samuel Rosenberg, tanner. The building will have a frontage of 30 ft. with a depth of 70 ft. Two electric elevators and machinery will be installed. The factory will be heated by steam. The cost of construction alone will be $8,000. Work on the structure will begin at once.

HENDERSON, N. C.—The Carolina Bagging Co., of Henderson, N. C., will rebuild its factory, which was destroyed by fire recently at a loss of $30,000.

CONCORD, N. C.—The Kerr Bleaching & Finishing Works will be rebuilt at Concord, N. C., where they were destroyed by fire This decision was made by the stockholders of the company at a meeting held recently. The management will make the necessary arrangements to construct modern buildings and install machinery at once. They will complete the plant by February.

ERWIN, TENN.—The general shops of the Carolina, Clinchfield & Ohio Ry. Co., have been located at Erwin, a small town on this line, 16 miles south of Johnson City. The contract for the grading has been let to RHEINHART & CO., and work is to begin at once. In these shops will be employed from 2,500 to 3,500 men. M. J. Caples, Johnson City, is Vice-Pres., Gen. Mgr. and Ch. Engr.

GARY, IND.—The PENN BRIDGE CO., of College Hill, Beaver Falls, Pa., has been awarded the contract by the U. S. Steel Corporation for the iron work on the plant now in course of erection by the company at Gary, Ind.

EVANSVILLE, IND. — The Evansville Packing Co. has awarded a contract for the construction of a $30,000 addition to its plant to the NATIONAL CONSTRUCTION CO., of Louisville.

NEWCASTLE, IND.—Charles W. Mouch, Gen. Mgr., for the Indiana Rolling Mill Co., has authorized the erection of four additions to the plant here. These additions include finishing, polishing and varnishing departments, large green handle storeroom and office. About $100,000 will be expended in buildings and equipment.

BEAUMONT, TEX.—The Southern Car Mfg. & Foundry Co., has awarded contract to WILLIAM RENFROE, Beaumont, for improvements to the plant, including erection of one large building and several smaller ones. The large building will form part of the present structure, which will be remodeled and widened, cement floors installed and walls heightened. When finished this structure will be 27 × 135 ft. Another building will be erected, 75 × 91 ft., and will be equipped for manufacturing and assembling machinery. A fuel house and building for storing iron material used in foundry department will be erected. Additional machinery will be installed.

COMANCHE TEX.—Comanche Brick Co., incorporated with $100,000 capital stock by T. P. Daniels, Pittsburg, Pa.; H. C. Mead, Bessemer, Ala., and Charles J. Hobart, Willoughby, Ohio. The company will establish a plant at Comanche to manufacture building brick from sand and lime, and has awarded contract to the AMERICAN CLAY MACHINERY CO., Willoughby, Ohio., for furnishing and installing machinery. Total cost of plant, $50,000.

FORT WILLIAM, ONT.—Frank W. Morse, Vice-Pres. and Gen. Mgr., Grand Trunk Pacific Ry. Co., Montreal, Que, writes us that "contract for the construction of the initial unit of elevator at Fort William to have a storage capacity of 3,250,000 bushels, has been awarded to the CANADIAN STEWART CO., Montreal. The plant is being planned to admit of development to a capacity of 40,000,000 bushels, in the future. With regard to the report that we have in contemplation a chain of elevators along our line: We have already completed one having a capacity of 2,000,000 bushels at Midland, Ont. It was put in operation the latter part of last month. Country or interior elevators, in which the farmers deposit their grain, are being erected at numerous stations along our line between Winnipeg and Edmonton; these are being erected by different elevator companies and private individuals, we leasing the sites to them."

MISCELLANEOUS CONTRACTS.

U. S. RECLAMATION SERVICE.—Items regarding irrigation, canal projects, etc., will be found under Water Supply—Irrigation.

HYDROTHERAPEUTIC EQUIPMENT.—Hot Springs, S. Dak.—See item under Buildings.

*GREENHOUSES.—Albany, N. Y.—Bids are asked until 3 p. m., Dec. 2, by the State Commission in Lunacy for construction of greenhouses at Middletown State Hospital.

DREDGING.—Oakland, Cal.—Bids will be received until noon, Dec. 12, by Lieut.-Col. John Biddle, Corps Engrs., U. S. A., San Francisco, for dredging in Oakland Harbor, Cal.

DRAIN.—Boone, Iowa.—Bids will be received until Nov. 27 by E. F. Jones, County Audr., for constructing County Drain No. 58, Union Township, and No. 53, Beaver Township.

DRAIN.—De Kalb, Ill.—Bids are asked until noon, Dec. 4, by the Drainage Commissioners of Union District No. 1, Towns of Malta and De Kalb, for constructing about 5,920 ft. of 18, 22 and 24-in. tile drain.

SETTEES.—New York, N. Y.—Bids are asked until 3 p. m., Dec. 3, by the Park Board, Henry Smith, Pres., for furnishing 1,000 large settees (Sample No. 1) and 1,000 small settees (Sample No. 2), Boro. of Manhattan.

*TILE.—Cerro Gordo, Ill.—Bids are asked until Dec. 4 for furnishing, hauling and laying about 13,000 ft. of tile from 5 to 24-in. Profiles in office of J. C. Locher, Town Clerk, Cerro Gordo, Ill. Bids will be received for parts or all of the work.

PIPE FENCES.—New York, N. Y.—Bids are asked until 3 p. m., Dec. 3, by the Park Board, Henry Smith, Pres., for furnishing and erecting 3-rail pipe fences around the grass plots in Tompkins Sq. Park, Boro. of Manhattan, the City of New York.

WHARF, DREDGING.—Norfolk, Va.—Bids are asked until 11 a. m., Dec. 5, by the Bureau of Yards and Docks, Navy Dept., Washington, for a timber wharf about 350 ft. by 50 ft., and for dredging about 40,000 cu. yds. of mud, etc., at the navy yard, Norfolk, Va.

REPAIRING FERRYBOATS.—New York, N. Y.—Bids are asked by Allen N. Spooner, Dock Comr., until noon, Dec. 3, for furnishing all the labor and materials required for repairing the municipal ferryboats, or other floating ferry property, and furnishing and delivering supplies therefor.

RAILING.—New York, N. Y.—Bids are asked until 3 p. m., Dec. 3, by the Park Board, Henry Smith, Pres., for all the labor and materials required for furnishing and erecting an iron railing around the grass plot in Broadway, between 60th and 61st Sts., Boro. of Manhattan, The City of New York.

DRAIN.—Trenton, N. J.—Bids are asked until 8 p. m., Dec. 1, by the Common Council for the construction of a drain beginning at a point in the southerly line of Muirhead St., thence northerly across Muirhead St. and across lands of the Greenwood China Co. to the southerly line of lands of the Delaware and Raritan Canal. Harry B. Salter is City Clk.

DITCH.—Corning, Ark.—Bids were received on Nov. 14 by the Board of Directors of the Western Clay Drainage District, Chas. W. Jones, Secy., for digging and constructing main ditch and laterals. Estimated quantity, 724,757 cu. yds. J. D. Mitchell, Engr., Greenway, Ark. Contract awarded to COLE DREDGING CO., Jonesboro, Ark., at estimated cost of $80,000.

*BARGE CANAL.—Albany, N. Y.—The lowest bid received by F. C. Stevens, Supt. Public Works, on Nov. 18, on Barge Canal Contract No. 41, which is for building embankments at Irondequit Creek Crossing, was that of Butler Bros.-Hoff Co., 170 Broadway, New York, at $281,330. Enginer's estimate, $283,190. Itemized prizes will be given next week under Contract Prices.

DREDGING.—Albany, N. Y.—Bids are asked by F. C. Stevens, Supt. Public Works, until noon, Dec. 22, on Barge Canal Contract No. 20, which is for dredging a channel in the Mohawk River from Rexford Flats to Little Falls, a distance of over 58 miles. This is a readvertisement for bids since no bids were received on the former call. The cost of the work will exceed $4,000,000.

DITCH.—Paragould, Ark.—Bids were received on Nov. 17 at the County Court-House, Paragould, for construction of a ditch to straighten Eight Mile Creek, Cache River Drainage Dist. No. 2. Total length, nine miles. Estimated quantity, 435,546 cu. yds. Ditch starts in the town of Paragould and extends to the St. Francis River. Lund & Hill, Consult. Engrs., Little Rock, Ark. Contract was awarded to COLEMAN & SONS, Walcott, Ark., at 10 cts. per cu. yd.

DREDGING.—Boston, Mass.—Bids are asked by the Board of Harbor and Land Commissioners, Boston, until 2 p. m., Dec. 4, for dredging the channel of the South River, Salem. The work to be done is the dredging of about 22,000 cu. yds., scow measurement, of material to make the channel 8 ft. deep at mean low water, from about 200 ft. below Union St. bridge to the westerly boundary of the Salem Electric Lighting Co.'s premises, a distance of about 1,300 ft.

DAM, ETC.—Chicago, Ill.—Bids were received on Nov. 18 by the Clerk of the Sanitary District of Chicago for building a reinforced-concrete dam, and for performing certain collateral bridge work. The work includes the excavation of about 210,000 cu. yds. of earth, the building of a reinforced-concrete dam on the north branch of the Chicago River, the construction of bridges, etc. The lowest bidder was the American Engineering & Construction Co., Chicago, at $76,699. For details see under Bridges.

SUPPLIES.—Toronto, Ont.—Bids are asked by Joseph Oliver, Chn. Board of Control, until noon, Dec. 1, for annual supplies for the year ending Dec. 31, 1909: Lumber, pit gravel (screened and unscreened), sand, cement, sewer pipe, brass and bronze castings, brasswork for house services, lead pipe, stop valves, special castings, crushed stone, paving bricks, cedar posts, rubble stone, stone for street purposes, steel and house numbers, street signs, hardware, etc., sewer brick, hydrants, lubricating oils, rubber valves, etc., iron valve and stop cock boxes, iron and steel, asphalt, limestone dust, petroleum residuum, sand.

DOCK.—Erie, Pa.—Bids were received as follows on Nov. 14 by the Public Dock Commission for overhead construction work on the new dock at the foot of State St.: Rogers Bros., Albion, Pa., $12,700; Mulcaughy & Walther, Erie, Pa., $12,534; Riverside Bridge Co. Martins Ferry, Ohio, $12,800; T. H. Brooks & Co., Cleveland, Ohio, $14,157; Standard Construction Co., Cleveland, Ohio, $13,405; Erie Car Works, Erie, $12,900; South Shore Construction Co., Erie, $13,882; American Bridge Co., New York, $15,633; McCLINTIC-MARSHALL CONSTRUCTION CO., Park Bldg., Pittsburg, $12,290 (awarded contract); Pennsylvania Bridge Co., Beaver Falls, Pa., $13,490.

TUNNEL.—Tacoma, Wash.—The Oregon & Washington Ry. Co. invites bids for the construction of a tunnel in Tacoma. It will have its north portal between 23d and 25th Sts. and Jefferson Ave. and Hood St. It will be 8,700 ft. long, built for two tracks. It will have a maximum grade of 1.25 per cent. and will necessitate the removal of approximately 400,000 cu. ft. of earth. About one-half mile of steel construction, in addition to a new drawbridge, is included in the plans. The estimated cost for the tunnel is $3,000,000, and for the steel work $2,000,000. It has not been decided when the contract will be awarded or when construction will be begun. H. F. Baldwin is Ch. Engr.

RIVER AND HARBOR IMPROVEMENTS.—Washington, D. C.—Recommendation is made in the annual report of the Chief of Engineers, U. S. A., for the following appropriations for improvement of rivers and harbors, fortifications, etc. For rivers and harbors for the fiscal year ending June 30, 1910: Under continuing contracts, $20,479,057; rivers and harbors (general, including examinations, surveys, and contingencies), $21,464,141; under California Debris Commission (expenses), $15,000; prevention of deposits in New York Harbor, $155,200; enlargement of Governors Island, New York, $75,000. In addition to the above, the Mississippi River Commission submits an estimate amounting to $3,000,000, reduced in the Chief Engineer's office to $2,000,000.

Estimates of appropriations required for 1909-1910 for fortifications: Gun and mortar batteries—for construction of gun and mortar batteries, $5,064; for moderanizing older emplacements, $500,000; electrical installations at seacoast fortifications, $984,253; sites for fortifications and seacoast defenses, $250,000; searchlights for harbor defenses, $307,000; preservation and repair of fortifications, $300,000; repair and protection of defenses of Pensacola, Fla., for sea walls, $507,100; repair and protection of defenses of New Orleans, La., $40,000; plans for fortifications, $5,000; supplies for seacoast defenses, $64,500; sea walls and embankments, $145,914; sea walls, defenses of Galveston, Tex., for Fort Travis, $440,000; preservation and repair of torpedo structures, $50,000; casemates, galleries, etc., for submarine mines, $280,964.

Fortifications in insular possessions: For seacoast batteries—Honolulu and Pearl Harbor, $449,400; Manila, P. I., $2,369,000; for installation of electric plants, Honolulu and Pearl Harbor, $14,409; Philippine Islands, $216,169; for searchlights, Pearl Harbor and Honolulu, $12,800; Philippine Islands, $81,000. Total, $7,732,223. List of proposed improvements in detail with appropriation recommended will be given next week under Miscellaneous Contracts.

For other Proposal Advertisements see pages 43, 44, 46, 47, 50, of Advertisements and Construction News page 192.

CAST-IRON PIPE AND SPECIAL CASTINGS.

NOTICE TO CONTRACTORS.

Amsterdam, N. Y.

Sealed proposals for furnishing cast-iron water pipe and special castings will be received by the Board of Water Commissioners of the City of Amsterdam, N. Y., at their office in the Farmers' Bank Building, until 8 o'clock p. m. of November 24th, 1908, at which hour said proposals shall be opened and read in the presence of said Water Commissioners.

All proposals shall be enclosed in a sealed envelope addressed to Charles C. Yund, President of the Board of Water Commissioners, Amsterdam, N. Y., and across the end of such envelope and upon the face side of same, the words "Proposal for Cast-Iron Pipe for Hanns Creek Conduit No. 2" shall be written.

Each proposal shall contain a certified check or a New York or Boston draft in the amount of $10,000 (ten thousand dollars) payable to the order of John J. Turner, the Treasurer of the Water Commissioners, Amsterdam, N. Y., as a guarantee that the bidder will enter into contract in case of award to him, or in case of his failure so to do, then said amount shall be absolutely forfeited to said water commissioners.

No checks or drafts thus presented to the Board of Water Commissioners, shall be returned to the bidders until after the award and signing of the contract and the furnishing of satisfactory sureties and bond for faithful performance by the successful proposer. No bids shall be withdrawn after they have been opened by the Water Commissioners.

The Board of Water Commissioners expressly reserves the right to reject any or all proposals if such action appears to them to be for the best interests of the city. Specifications and proposal sheet for this contract may be procured by intending bidders, by application to James R. Snell, Superintendent of the Water-Works, after November 12th, 1908.

Approximate Quantities.

The approximate quantities in net tons are as follows:

30 inch straight piping	3,538
24 inch straight piping	3,844
Smaller sizes, straight piping	16½
30 inch special castings	25
24 inch special castings	20
30 inch inspection castings	16
24 inch inspection castings	20

CHARLES C. YUND.
President of the Board of Water Commissioners, Amsterdam, N. Y.
FRANK H. M'CONNELL,
Secretary of the Board of Water Commissioners, Amsterdam, N. Y.

NOTICE.—Date of opening these proposals postponed to Dec. 1, 1908, at 8 p. m.

SEWAGE PUMPING MACHINERY.

CHANGE OF DATE.

Grand Rapids, Mich., Oct. 31, 1908.
Office of Board of Public Works.

Sealed proposals will be received at the office of the Board until Thursday, Dec. 10th, 1908, at 8:00 P. M., for sewage pumping station machinery consisting in general of four 40-inch, four 24-inch, and two 18-inch centrifugal pumps; four 175-HP., two 75-HP., two 60-HP., and three 30-HP. electric motors, together with vacuum pumps, piping, etc., according to the plans and specifications on file at the office of the City Engineer.

The Board reserves the right to reject any or all bids.

Each bidder shall deposit with his proposal a certified check or certificate of deposit, payable to the order of George C. Peirce, President, in the sum of five (5) per cent. of his proposal, to be forfeited to the City of Grand Rapids in case he shall fail to enter into contract, in accordance with his proposal, should his proposal be accepted by the Board of Public Works.

All proposals must be made upon blanks accompanying specifications. By order of the Board.

GEORGE C. PEIRCE,
President.
SAMUEL A. FRESHNEY,
Secy. and Gen. Mgr.
L. W. ANDERSON,
City Engineer.

SEWER.

OFFICE OF THE COMMISSIONERS OF SEWERAGE OF LOUISVILLE, KY.
Incorporated.

Sealed proposals for the construction of a sewer known as the Beargrass Interceptor, Section "D," Contract No. 16 of the Comprehensive System of Sewerage for the City of Louisville, Ky., will be received at the office of the Commissioners of Sewerage until 12 o'clock noon, December 18th, 1908.

The work will consist mainly of building a sewer to be constructed of reinforced concrete as follows: 2,400 feet of 54-inch sewer, depth of cut, 18 ft. to 30 ft., approximately 900 cu. yds. of concrete, and approximately 72,000 lbs. of steel reinforcing bars.

Plans and specifications may be seen at the office of the Commissioners and at the office of Harrison P. Eddy, Consulting Engineer, 14 Beacon St., Boston, Mass.

Sealed bids should be endorsed "Proposals for the Beargrass Intercepter, Section "D," and addressed to the Commissioners of Sewerage, Equitable Building, Louisville, Ky. Each bid must be accompanied by a certified check for at least seven per cent. (7%) of the total amount of the bid, or a "Bidder's Bond," as described in the form of proposal.

P. L. ATHERTON, Chairman.
CHAS. P. WEAVER, Secy. & Treas.
J. B. F. BREED, Chief Engineer.

SEWER.

OFFICE OF THE COMMISSIONERS OF SEWERAGE OF LOUISVILLE, KY.
Incorporated.

Sealed proposals for the construction of a sewer known as the 29th Street Sewer, Contract No. 15 of the Comprehensive System of Sewerage for the City of Louisville, Ky., will be received at the office of the Commissioners of Sewerage until 12 o'clock noon, December 18th, 1908.

The work will consist mainly of building a sewer, to be constructed of concrete as follows: 400 ft. 27-inch diameter; 400 feet 39-inch diameter; 400 feet 42-inch diameter; 400 feet 48-inch diameter; 450 feet 51-inch diameter; 400 feet of 18-inch vitrified clay pipe; depth of cut, 6 ft. to 15 ft.; approximately 550 cu. yds. of concrete.

Plans and specifications may be seen at the office of the Commissioners, and at the office of Harrison P. Eddy, Consulting Engineer, 14 Beacon St., Boston, Mass.

Sealed bids should be endorsed "Proposals for the 29th Street Sewer," and addressed to the Commissioners of Sewerage, Equitable Building, Louisville, Ky. Each bid must be accompanied by a certified check for at least seven per cent. (7%) of the total amount of the bid, or a "Bidder's Bond," as described in the form of proposal.

P. L. ATHERTON, Chairman.
CHAS. P. WEAVER, Secy. & Treas.
J. B. F. BREED, Chief Engineer.

Situations Wanted

Mechanical and Electrical Engineers.

MECHANICAL ENGINEER, several years' experience in building construction and power plant work, desires position as salesman for firm handling building material or power plant appliances. Address "Z. A. 22," Engineering News, New York. 22-4t

Bridge and Structural Engineers.

FIRST-CLASS structural checker and squadman, ten years' experience, at present employed, wishes to change position. Address "R. A. 22," Engineering News, New York. 22-4t

GRADUATE MECHANICAL ENGINEER desires position as detailer or draftsman; 4 years' practical experience; best references furnished; moderate salary accepted. Address "K. 20," Engineering News, New York. 22-1t

Draftsmen.

MECHANICAL DRAFTSMAN (21), desires position, moderate salary; technical education and five years' experience in designing crushing, grinding and drying machinery, and brick plants. Address "P. A. 22," Engineering News, New York. 22-1t

Superintendents, Misc., etc.

POSITION as general foreman wanted by competent man, 35 years of age, having twelve years' practical experience as foreman on construction of water-works, sewers, reservoirs, dams and roads; best of references. Address "I. 18," Engineering News, New York. 22-2t

Situations Open

WANTED.—Three graduate engineers, thoroughly experienced in calculating and detailing railway bridges. State fully education, experience and salary. WADDELL AND HARRINGTON, Kansas City, Missouri. 22-1t

WANTED.—First-class copyist, marine engine and boiler draftsman, at $3.28 per diem. A competitive examination will be held at the Navy Yard, Norfolk, Va., December 7, 1908, to fill the above position. For application and further information, address "COMMANDANT," Navy Yard, Norfolk, Va. 22-1t

FOR SALE

FOR SALE.

Complete Foundry and Machine Shop

In running order. In heart of Bituminous Coal Field. Will sacrifice if sold immediately.

HOWARD W. REAT,
Third & Arch Sts., Philadelphia, Pa. 22-2